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Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	E. K Bull	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Maui Agricultural Co		H. A. Baldwin	Paia
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paaullo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paaullo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	J. M. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	**x	Jas. Webster	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. H. Campbell	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	Wm. G Ogg	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	H H. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
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Olaa Sugar Co.	xx	J. Watt	Olaa
Puna Sugar Co.			Kapoho
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Puako Plantation	††	Jno. C. Searle	S. Kohala
Niulli Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	* x	H. R. Bryant	Kohala
KAUAI.			
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Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.	.....	G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
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Koloa Sugar Co.	x	F. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.

	Castle & Cooke ( )
**	W. G. Irwin & Co. (8)
***	J. M. Dowsett (1)
x	H. Hackfeld & Co. (9)
*x	T. H. Davies & Co. (8)
**x	C. Brewer & Co. (6)
x*	Alexander & Baldwin (6)
x**	F. A. Schaefer & Co. (2)
x*x	H. Waterhouse Trust Co. (2)
††	Hind, Rolph & Co. (2)
xx	Bishop & Co. (1)

HONOLULU AGENTS.

THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

[Entered at the Post Office at Honolulu, T. H., as Second-class matter.]

VOL. XXV.] HONOLULU, DECEMBER 15, 1906. [No. 12.

NOTES.

This number of the Planters' Monthly is entirely devoted to the publication of a number of reports presented at the annual meeting of the Hawaiian Sugar Planters' Association.

Sugar prices for month ending December 21, 1907:

	Centrifugals.	Beets.
November 16	3.81625c.	8s. 9d.
" 23	3.82c.	8s. 9d.
" 30	3.84375c.	8s. 11¼d.
December 7	3.84375c.	9s. 1½d.
" 14	3.82c.	8s. 9d.
" 21	3.58c.	8s. 10½d.

Under date of December 13, Messrs. Willett & Gray state:

Raws.—During the week under review the market has been characterized by unusual irregularity. The local market for nearby sugars showed a remarkable firmness, which was due to a special demand. The refiners generally are fairly well supplied with raws, except one or two of them who found their stock nearly exhausted, because of the delay in the arrival of several cargoes afloat and making it necessary to bid the market up in order to secure enough sugar to fill a temporary gap; the result was that the only sugars immediately available, a cargo of Javas arrived at the Breakwater, was sold at 10s. 1½d. c. f. and i., equal, at present low rate of exchange, to 3⅞c. duty paid, for 96° test, and establishing an advance of 1-32c. in spot quotations.

On the next day a small cargo of Surinam Centrifugals, due to arrive end of December, was placed at 3.82c. landed.

The general position, however, was weaker, the holders in Cuba, after meeting the demand freely, having continued to press their sugars for future delivery on buyers who were already well filled. A considerable business was done in Centrifugals for December-January shipment at 2 3-8c. c. and f. (equal 3.74c. landed) and in San Domingo sugars at equivalent figures, followed by sales of

February shipment at 2¼c. c. and f. (3.61c. landed) for 96° test, with sellers of January at 2 5-16c. c. and f., showing a decline of ⅛c. in distant sugars for the week.

At the close the market for February shipment is steady, but with buyers showing indifference to offerings of January shipment.

European markets also exhibited weakness, with a decline in both cane and beet of 3d. for the week. Beet at the close is quoted 8s. 10½d. for prompt and 9s. 2¼d. for May.

Receipts at the four ports of the United States for the week amounted to only 7,580 tons, against requirements of 32,000 tons for meltings, but the arrivals next week and later will unquestionably be much more liberal, so that all refiners' wants are likely to be well covered and spot quotations may be expected to decline gradually and perhaps rapidly to the level of prices for future deliveries.

Harvesting in Cuba is progressing favorably, the number of centrals grinding having increased to 58, against 6 at same time last year and 45 in 1904. At this rate of progress the crop will soon be in full swing, assuring large shipments during January and thereafter.

As anticipated, our correspondents in Havana report that there is sufficient cane in the fields to produce a crop of 1,500,000 tons sugar, but with the supply of laborers limited and the possibility of political disturbances a little later on, we do not feel justified in making any change in our estimate of a total outturn of 1,250,000 tons sugar.

The lowest price touched last season was 2c. c. and f. (Feb. 8th) for Cubas, 96° test (3.36c. landed), but there does not appear to be good reasons to expect quite so much of a decline this season. In any event, the average price for January-June, 1907, deliveries should be rather higher than that for the same time in 1906, as it will be realized, sooner or later, that all the sugar which Cuba can produce this season will be wanted.

The outlook for the 1907-08 sugar crop of Java is promising, it being estimated, according to our special cable, at 1,000,000 tons, against the present crop of 950,000 tons.

Cuba Crop Estimate.—Our regular correspondents in Havana cabled us December 12th: "Sufficient cane in the fields to produce 1,500,000 tons sugar."

This is the report anticipated when we wrote on November 28th: "Our correspondents are obtaining exact reports from each central and estate in the island on this particular point of quantity of cane, independent of the labor question and weather conditions, and will soon advise us by cable of estimate of crop, based wholly and solely upon the amount of cane available. No doubt this estimate will surprise many by its large size. Therefore, we call attention

beforehand, in order that sufficient allowances may be made for inability to turn the entire crop of cane into sugar."

In view of the scarcity of labor in some parts and of political disturbances, as well as of possible unfavorable weather conditions, we are still of the opinion that the Cuban planters will do very well if their total production this season reaches 1,250,000 tons sugar, and, therefore, we leave our estimate unchanged at this figure.

Last season there was sufficient cane to produce 1,400,000 tons sugar, but the total outturn proved to be 1,178,749 tons.

ANNUAL MEETING HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

The twenty-sixth annual meeting of the Hawaiian Sugar Planters' Association was held at Honolulu, November 20 to 23, 1906, Vice-President F. A. Schaefer presiding. The meeting was well attended, the following members being present:

Andrew Adams, B. D. Baldwin, E. K. Bull, E. H. Broadbent, W. H. C. Campbell, George Chalmers, C. M. Cooke, T. C. Davies, C. F. Eckart, G. W. Ewart, J. Fassoth, D. Forbes, A. Gartenberg, George Gibb, James Gibb, W. M. Giffard, K. S. Gjerdrum, W. W. Goodale, A. Garvie, J. F. C. Hagens, W. W. Hall, C. Hedemann, G. C. Hewitt, John Hind, A. Horner, T. S. Kay, R. D. Mead, J. T. Moir, E. E. Paxton, W. Pfotenhauer, W. Pullar, F. A. Schaefer, J. A. Scott, James Scott, W. O. Smith, J. G. Spencer, Wm. Stodart, F. Scott, Wm. Searby, E. D. Tenney, John Watt, W. G. Walker, F. Weber, J. N. S. Williams, G. N. Wilcox, A. S. Wilcox, C. Woiters, E. H. Wodehouse, L. Weinzheimer, Dr. N. A. Cobb, Dr. R. C. L. Perkins and Mr. C. F Eckart, Directors of the Experiment Station, were also in attendance during most of the time.

The secretary read a short address of the retiring president, H. P. Baldwin—Mr. Baldwin being unavoidably absent on the Mainland—as follows:

To the Members of the Hawaiian Sugar Planters' Association:

The past year has been the second in the history of the Hawaiian Sugar Planters' Association that I have had the honor of holding the executive office. When first I was president in 1898 the sugar crop of these Islands was approximately 230,000 tons, and in the intervening time we have seen this production increase to almost double that amount.

We may well congratulate ourselves upon the rapid progress already made, and rejoice that the infancy of the work has been safely passed, but we must not forget that there are dangers and difficulties still ahead, and that only hard work, good judgment and coöperation will prevent disaster.

Our production has reached a point where we can see the limit

of the arable areas suitable for the cultivation of sugar cane, and one of our great practical questions is how to increase and conserve the productive power of our agricultural lands. Scientific work on broad lines will be the main factor of future importance to the sugar industry of this country.

The investigations and lines of work conducted by your Experiment Station are of growing importance and it should be the endeavor of all engaged in the cultivation of sugar cane to obtain all possible profit therefrom. Farming in all its varied branches is fast becoming a science, and the most successful farmer or cane sugar planter is the one who understands the application of scientific principles to the work he has in hand.

The past year has been for nearly all plantations a fairly successful one from the financial point of view. While during the early part of the marketing season the prevailing price of sugar was too low to admit of much profit, the market strengthened materially after about one-half the crop had gone forward and these conditions remained favorable until the end of the season. The crop produced was 429,213 tons, being the second largest in the history of our industry.

The prevailing shortage of labor on the islands of Hawaii, Maui and Kauai is undoubtedly responsible for a somewhat smaller yield than was originally expected. Fortunately the leaf-hopper and other insect pests and cane diseases were kept well in check and no appreciable mark was made by them on the total outturn of the plantations.

Our most serious difficulty now is the ever recurring question of an adequate supply of labor to operate the plantations, and your Board of Trustees has wrestled with all phases of this problem. The departure to the Coast of so many of our Japanese laborers, leaving vacancies that are not filled by the new arrivals, is responsible for the large shortage of the plantations.

With all the troubles that the plantations have had with their Japanese laborers, it is gratifying to know that the emigration of Portuguese has been reopened through the auspices of the Territorial Board of Immigration. The first shipment of these people is about due, and, we are told, consists of ... families, comprising all told 1325 souls.

The agents of the Board of Immigration are now in Italy investigating that field and will also go to Spain for the same purpose. The liberal terms which have been offered these white immigrants are such as ought to induce them to stay on the plantations, and we all hope that we have laid the foundation of a permanent class of settlers who will prove of value as plantation laborers.

Other immigration schemes are under consideration, and an experiment will soon commence with Filipinos who have been obtained from what we are told is the most industrious tribe in the Philippines, but at present very little can be said on this matter.

The work at the Experiment Station during the year has progressed under favorable conditions. There have been no changes in the staff, and accordingly no interruption in the lines of investigation which have been in progress. Much credit is due to the members of the Experiment Station Committee for their very able supervision of this department. It is unfortunate that the agricultural work of the Experiment Station is so localized; and in order that the best results may be obtained I deem it very desirable and important that sub-stations should be established in the various districts of the Islands where the soil and climatic conditions are different from those at the main Station.

I will not attempt to enumerate the various matters of importance arising and acted upon during the past year. It is sufficient for me to say that in all matters your Board of Trustees and the various persons connected with the Association in different capacities, here and elsewhere, have labored faithfully to serve the best interests of the sugar industry of these Islands.

I regret exceedingly that circumstances prevent my attendance at this meeting, and at the dinner which you give on Thursday evening of this week. I am heartily in favor of the present system of annual meetings, and believe that the free interchange of ideas is helpful to us all and I hope that you will all do what you can to make a sucess of this and of all future annual meetings.

It has been customary to hold the annual meeting in the month of November, and I am informed that the attendance this year is larger than ordinarily. But, for the managers on the island of Maui, it would be more convenient if the meeting could be held in the month of October; the grinding season usually begins about the first of December and it is impossible for these managers to come to the meeting, much as they would like to. If the date of the meeting could be changed to October, I am sure that these managers would appreciate it. I bring this matter up as a subject for discussion.

I desire to impress upon you the necessity of coöperation in all the work which the Association undertakes. We are all working for one end, and our only hope of surmounting difficulties is to pull together for the benefit of all.

H. P. BALDWIN,
President H. S. P. A.

The following report of the secretary of the Association,—Mr. William O. Smith,—was thereupon presented and read:

SECRETARY'S REPORT.

The last annual meeting of the Association was held November 20-23, 1905, inclusive, in the rooms of the Association in Honolulu.

At that meeting the following named Trustees were elected: H. P. Baldwin, F. A. Schaefer, F. M. Swanzy, E. D. Tenney,

W. G. Irwin, W. Pfotenhauer, S. M. Damon, G. H. Robertson and W. O. Smith.

The Trustees organized and elected the following officers:

President.....H. P. Baldwin
Vice-President.....G. H. Robertson
Secretary and Treasurer.....W. O. Smith
Auditor.....E. F. Bishop

Later Mr. Robertson resigned as vice-president and Trustee and Mr. E. F. Bishop was elected in his stead.

The committees appointed by the President were as follows:

Experiment Station—W. M. Giffard, chairman; E. D. Tenney, E. E. Paxton.

Cultivation—G. H. Fairchild, chairman; E. K. Bull, L. Barkhausen, A. Horner, J. A. Scott.

Fertilization—D. Forbes, chairman; J. Watt, C. Chalmers, W. Stodart, C. E. Wells.

Irrigation—J. A. Low, chairman; W. W. Goodale, M. M. O'Shaughnessy, L. Weinzheimer, John Hind.

Handling and Transportation of Cane—H. A. Baldwin, chairman; C. C. Kennedy, A. Lidgate, A. Adams, H. P. Faye.

Manufacture—J. N. S. Williams, chairman; James Webster, James Gibb, W. W. Goodale, F. Weber, W. Searby.

Machinery—W. J. Dyer, chairman; B. D. Baldwin, W. Pullar, James Scott, C. Wolters.

Utilization of By-Products—G. F. Renton, chairman; W. G. Walker, W. G. Ogg, J. N. S. Williams, G. H. Fairchild.

Forestry—L. A. Thurston, chairman; C. McLennan, J. Ross, J. M. Lydgate, T. S. Kay.

Labor Saving Devices—J. T. Moir, chairman; H. H. Renton, F. Meyer, J. A. Low, H. A. Baldwin.

Labor—J. P. Cooke, chairman; F. M. Swanzy, W. Pfotenhauer, R. D. Mead.

The Board of Trustees have held forty-five meetings during the year, and many matters of interest and importance have been before them.

The question of a sufficient supply of labor for the plantations has been before the Trustees throughout the year.

The Labor Committee will report in detail upon this subject and will give you all available statistics as to the supply of labor on the plantations and the arrivals and departures at and from Honolulu.

Submitted herewith are the returns of the crop from 1905-1906, which show a tonnage of 429,213, which is next to the largest crop in the history of the Islands.

The shortage of labor very greatly delayed operations on many of the plantations and in some instances returns of individual plantations shown in the printed statement do not represent the entire crop as the grinding extended beyond the 30th of September.

Delay in the harvesting and the marketing of the crop worked

to the advantage of the plantations in so far as the prices of sugar were concerned, as at the beginning of the season low prices were the rule, but the market materially strengthened after about half the crop had been marketed.

The crop of 1906-1907 is roughly estimated at about 390,000 tons.

The plan adopted at the meeting of three years ago of having the reports printed and ready for distribution before the meeting, has been carried out as far as possible this year. Some of the committees, however, have failed to hand in reports.

The Experiment Station have constantly under consideration matters relating to fertilization, cultivation and irrigation, and there is very little to be said on these subjects to supplement the bulletins issued by the Station.

The importance of the Experiment Station and the work which is being carried on there cannot be overestimated. We all know what magnificent results were obtained in securing parasites of the leaf-hopper by the entomological division, and the investigations and experiments now being carried on in the lines of breeding and selection of varieties of sugar cane promise very well and the Directors of the Station feel hopeful that canes may be developed to be of a superior class to any now grown here.

Mr. Giffard, who consented to again accept the chairmanship of the committee for this year, has continued to devote much time to the Station, and the Association is largely indebted to him for the interest which he has taken in this work.

WILLIAM O. SMITH,
Secretary.

Honolulu, Nov. 20, 1906.

The retiring Board of Trustees was thereupon nominated for re-election, and at a subsequent recess the Board selected its officers. The Board of Trustees so elected is thus constituted:

E. F. Bishop.....President
F. A. Schaefer.....Vice-President
W. O. Smith.....Secretary and Treasurer
G. H. Robertson.....Auditor

W. G. Irwin, F M. Swanzy, E. D. Tenney, W. Pfotenhauer, H. P. Baldwin and S. M. Damon.

The first report on the program of the meeting was that of the committee in charge of the Experiment Station and the same was presented and read by Mr. W. M. Giffard, chairman of the Committee; the reports of the different departments of the Station were presented by the Directors thereof. With the omission of certain matters of purely local interest, the complete report is here reproduced:

REPORT OF COMMITTEE IN CHARGE OF EXPERIMENT STATION.

To the President, Board of Trustees and Members of the Hawaiian Sugar Planters' Association.

The Commitee in charge of the Experiment Station hereby submits its Report for the twelve months ending September 30th, 1906.

DIVISION OF AGRICULTURE AND CHEMISTRY.

LABORATORY WORK.

As will be seen by the report of the Director the general analytical work performed by the laboratory during the past year represents the maximum amount done since the Experiment Station was established in 1895. The increase in the number of materials analyzed was 30% over that for the preceding year. On the other hand the analyses of fertilizers show a material falling off in numbers during 1906. In 1905, 453 samples of fertilizers were submitted to the laboratory, and in 1906, 315 samples, a reduction in numbers amounting to 30%. The average rebate per fertilizer shows an increase of about 16% over that for 1905 and represents the largest average rebate for a period of four years. Much closer conformance between manufacturers' guarantees and the Experiment Station findings has been manifested during the period subsequent to and including the year 1903 than that preceding it, as is shown by the figures for average rebates per fertilizer for the years 1900 to 1906. In 1900, 75 lots of mixed fertilizer showed an average discrepancy between the guaranteed analysis and the determinations of the Division's laboratory, amounting in value to $160.00 per lot. If the 315 lots of fertilizer analyzed in 1906 had shown this latter average deficiency, the total amount of rebate for the year would have been $50,400 instead of $4,560 as reported. This improvement in the conformance between guarantees and Station findings is very gratifying.

WEEKLY MILL REPORTS.

The Director reports that the number of plantation mills in the "exchange" was 27 for 1906, or a gain of 7 over that of 1905.

PROPAGATION AND DISTRIBUTION OF SEEDLINGS.

The propagation of "seedlings" from seed gathered at the Station from the tasselling season of 1905 was very successful. Very large numbers of these germinated, the most of which were finally planted out in the experimental area. A full account of

the number of seeds which germinated, the varieties of cane from which they were obtained, and the number of plants raised and set out is given in the Director's Report. Whilst a very large percentage of these seedlings will eventually prove valueless for practical plantation purposes, there is every reason to believe that from amongst them a fair number of very desirable new varieties will be raised. The limited area of land available at the Station for this Experimental work has been a great drawback in very many respects, and, unless a larger area is placed at the disposal of the Division, any desire that the Association might have for continued casual production of seedlings could not possibly be realized for the next three years or more. Your Committee has on this account instructed the Director to confine his attention in seedling work, for the time being, to the artificial cross-pollination between varieties of known parentage. By this means it is hoped that the Station will succeed in raising a few desirable hybrid canes capable of yielding heavily and, at the same time, of resisting our local fungus and insect pests. In any case, the number of seedlings so raised (if any) is likely to be comparatively small and, for the present at least, will not need any larger area of land than we already have available. As to the distribution of new seedlings already growing at the Station, your Committee does not consider it advisable to send out cuttings of these until about 3½ years at least have elapsed since the seed was sown, for the reason that during a period of less than 3½ years it would not be possible (1) to select seedlings according to field characters; (2) to test and select seedlings with respect to juice analysis, etc.; (3) to estimate the cropping value of the plants by plat tests; and (4) to grow sufficient seed cane from seedlings for distribution among the plantations. The seedlings should also be under observation sufficiently long to determine in some measure their relative powers of resistance to disease and insect attacks.

If canes were sent out to plantations before their merits and characteristics were somewhat definitely determined, it would not be long before a large number of worthless seedlings would be growing in plantation nurseries in the different island districts, and the liability of confusion arising over cane names and numbers would be great.

In the West Indies it is not the practice to send new seedling canes out to the plantations for trial on a small plat scale, until about four years after the sowing of the seed from which the varieties were obtained. In connection with the propagation of seedlings and distribution of cuttings from the same, your Committee submits the following extract from a late Bulletin of the Imperial Department of Agriculture for the West Indies:

"By means of a system of rigorous selection both in the fields and in the laboratory, several good varieties have been raised, but a large percentage of the seedlings produced, as was to be expected, has proved to be worthless. In any case, it took

several years before a seedling cane was sufficiently tested under varying conditions to deserve to be recommended to planters, and even then it was left to the planters themselves to make a final selection of those which were likely to be suitable for their purposes, as a seedling cane might give very good results in certain soils, or in a wet or dry season, while proving an utter failure in others."

The purpose of the "variety" Substations in the several districts now in course of organization, is here indicated, as by their means the final selection of the seedling cane suitable for either high or low elevations or wet or dry districts can be made.

DISTRICT SUBSTATIONS.

As will be seen from the report of the Director of this Division, the plans which were begun last year have been perfected for a system of Substations throughout the islands for the purpose of conducting agricultural tests with respect to fertilization, cultivation, etc., and also to determine the comparative value of introduced standard canes, and Hawaiian Grown Seedlings in different localities.

There is probably no cane growing country where the necessity for Substations for experimental purposes is so great as in Hawaii. These islands present variations of soil, elevation, rainfall and temperature, within the cultivable belt, to a greater extent than obtains in Louisiana or Cuba. These widely varying conditions render it impossible to apply the results determined by the experiments of a single Station to any considerable number of plantations. It has, therefore, been decided to carry out the plans already mentioned and establish Substations in each of these different localities so that experiments can be made under the particular conditions of each district.

The importance of testing, not only the introduced varieties of cane, but also the native grown seedlings, cannot be overestimated. With all the progress that has been made by our plantations in field methods and manufacture, the fact remains that there has been comparatively little advance in improving cane varieties with a view to increasing sucrose content in the canes and their power of resistance to pests and diseases. On the other hand, the value of beets has, through scientific experiments, been increased threefold since the industry was begun in America, and if it were not for the additional sugar content that has been thus obtained, it is certain that the Beet Industry would not have developed to its present status.

According to the plan outlined by the Director of this Division, ten new Substations will be started each year and a circular issued annually on or about October 1st outlining the nature of such experiments as are deemed advisable for the following season. It is intended that a Substation be located

on one plantation in each district each year so that eventually each and every plantation will have the benefit of having tests conducted within its boundaries.

The responsibility of seeing that the instructions of the Director of this Division are faithfully carried out at the various Substations rests with the Managers of the plantations where such stations may be located.

It is needless to say that, unless the field tests are carried out in the most accurate and conscientious manner, the results yielded by the experiments may prove not only worthless and misleading, but actually harmful. It is therefore, absolutely necessary that the Managers heartily coöperate with the scientific staff of the Experiment Station in direct charge of this work. These tests must be reduced to exact scientific measurement and calculation, as even the practiced eye of a plantation Manager will not be able to detect slight differences which might produce great results. For instance, in the diameter of certain varieties of canes the increase of a thirty-second of an inch would, as stated by Mr. Eckart, result in an increase of three tons of cane per acre, or 35,000 tons of sugar for the entire Islands.

Time, patience, and accurate scientific observation are the requisites for success in the conduct of an experiment station. Hawaii enjoys the distinction today of conducting the sugar industry as a whole on more scientific lines than any other country in the world. We feel assured that the plantation Managers on the various islands will recognize the benefits likely to accrue from the Substation experimental work carried on under the scientific direction of the best experts we can secure.

The possibility of adverse legislation affecting the market value of sugar, renders it a matter of first importance to the planting industry here to increase the yield of sugar per acre in every way possible, and there is no way to do this so economically as by adopting such methods of cultivation and selecting such cane varieties as will prove best adapted to the many varying conditions obtained in these islands.

BULLETINS AND CIRCULARS.

The Bulletins issued by this Division during the year have been as follows:

Bulletin No. 16, "The Influence of Stripping on the Yields of Cane and Sugar," contains the data derived from three series of stripping tests conducted at the Experiment Station. In this Bulletin it is shown conclusively that under certain conditions the practice of stripping cane materialy reduces the yields, especially where heavy fertilization has been followed. Stress is laid on the importance of carrying out carefully

planned experiments on the plantations to test the economy of stripping under various conditions.

Bulletin No. 17, "Comparative Tests with Varieties of Cane." This Bulletin gives the results obtained at the Experiment Station from plat tests with a number of imported varieties. Data is given showing the relative yields of cane and sugar, the difference between winter and summer growth, the relative recumbency of various canes, and the time and degree of tasselling. An endeavor is made to show that varieties which are almost or practically identical as far as external markings and ordinarily apparent characteristics are concerned, may be distinguished from each other by their relative resistance to winter influences, by their recumbency, and by their tasselling features.

Bulletin No. 18, "Hawaiian Waste Molasses." This Bulletin shows that the Java theory that the exhaustion of molasses is indicated by the ratio of Glucose to Ash, does not hold with respect to Hawaiian molasses. Data are given to show that the further recovery of sugar from molasses is closely controlled by the viscosity of the product, and that this viscosity originates with the gums.

Bulletin No. 19, "Lysimeter Experiments." Results are given showing the relative rate at which various nitrogenous fertilizer ingredients nitrify in the soil and furnish available supplies of nitrate to growing cane. The action of lime, ground coral, and gypsum, on a special soil type are also considered in some detail.

Details of the excellent work accomplished by this Division are very fully set forth by the Director in his report.

DIVISION OF ENTOMOLOGY.

RESULT OF WORK ON LEAF HOPPER AND OTHER INSECTS

Since the last annual report of your Committee, this Division has continued to confine practically all of its work to the introduction and breeding of beneficial insects and to the distributing of these on such plantations as are members of the Association. The result of the work of this Division in connection with cane leaf-hopper must be very gratifying to all plantations, and particularly to such as but a year or two ago suffered immense losses through the depredations of that serious pest. The persistent and excellent work of this Division in securing, breeding and distributing the several leaf-hopper egg parasites, which now overrun our plantations, has resulted in diminishing the attack of the hopper to such a degree that it is no longer feared and your Committee is in hopes that only sporadic attacks of this pest need be looked for hereafter. All that is now necessary to keep the pest under absolute control is a careful

and intelligent observation by all Managers that the parasites from the very beginning of an attack are generally distributed throughout their fields in proportion to the leaf-hopper present. To effect this, however, the young canes should be carefully watched by the Manager or his head overseer for the appearance of the first generation of the hopper, so that as soon as possible after its advent in these fields, the parasite can also be introduced if not there already in sufficient numbers to cope with the pest. The method of detecting the presence of the parasite in the egg of the hopper has been explained from time to time by the visiting entomologists of the Division and beyond a doubt very many Managers upon examination of their fields,, are able to tell when the parasite is present in more or less numbers. To such as are doubtful, however, your Committee cannot too strongly urge that the advice of the Division, viz.: that sections of cane leaves containing hopper eggs be immediately sent to the Station for examination, be at once complied with.

Leaf-hopper conditions in fields of young cane should never be allowed to be such that the first generation of the hopper attacking the cane cannot be controlled by the parasites there present. If there is no such control, then the Manager must expect a very severe attack of the pest in these fields until such time as the parasites have had an opportunity to practically outnumber the hoppers. Were it not for the practice of burning off of the trash in the fields after the harvesting of the cane, a practice which has to be adopted on the majority of plantations, there perhaps might not be such a necessity for the close observations of the fields of young cane, especially of those in the neighborhood of the burned area. The burning of the trash in the fields tends to smoke out the hoppers that are there, which, on account of their powers of flight, settle in more or less numbers in neighboring fields of growing cane, whilst the parasites, which are weak flyers, are all destroyed. It must therefore be apparent that, unless the parasites are generally distributed in sufficient numbers in any field, in which there were previously few or no hoppers, but which has had added to it numbers of adults from the burned area, an attack of more or less severity may ensue. As before stated, however, careful observation of these fields by the Manager will enable him to overcome the possibility of many of these sporadic attacks.

Whilst the work of the Division in practically stamping out leaf-hopper has necessarily taken up the most of its time, still the fact that other insects were occasionally doing more or less injury to the canes has not been lost sight of. The Aphis (cane louse) and cane borer have had the continued attention of the entomologists, and, as far as the first of these pests is concerned, large numbers of species of "ladybirds," which prey on

them, have been distributed to the plantations. These lady-birds in most instances, are new species which have been recently collected and introduced through the efforts of Messrs. Koebele and Muir of our staff.

The Director's report will inform you of the efforts made by Mr. Muir, during his recent visit to Fiji, to secure not only new parasites for leaf-hopper but also an enemy to our cane borer. Whilst to some extent successful in his search for enemies of the leaf-hopper, he was unfortunately unable to find in Fiji anything that would prove destructive to the borer. The Director has now sent him to China, Java and the Malay Archipelago, where it is hoped that he may meet with some success, not only in eventually securing something to prey on the cane-borer, but also in finding new leaf-hopper parasites in some of the cane fields of those countries. In connection with Mr. Muir's visit to the far East, your Committee takes the present opportunity of thanking Mr. R. de B. Layard, the British Consul at Honolulu, and the Governor of the Territory, for their united efforts in securing the proper credentials for Mr. Muir making it possible for him to travel through the interior of China with comparatively little danger. To Mr. Hedemann also, the thanks of the Committee are due for many valuable letters of introduction furnished to Mr. Muir to prominent sugar planters in Java.

Your Committee has every hope that much will eventually come of Mr. Muir's field work in the countries above named, but the greatest patience must be shown by all in this special work of seeking the proper enemies to insect pests. Managers must not look too soon for the success of the mission and, in fact, must control their disappointment should it turn out a failure. The fact that the Division so soon succeeded in diminishing the attack of leaf-hopper must not be a criterion in respect to cane-borer, as the difficulties in this case may be much greater, because the place of origin of the borer is not yet known, and, until that is found, it is not likely that any enemy to it will be secured.

Before closing the report on the work of this Division, your Committee wishes to emphasize the importance of individuals ceasing to import sugar cane unless under the supervision and control of the Experiment Station. A few stray consignments (which were destroyed by the Inspector after examination), were brought to this Territory during the past year and the fact that each lot contained either a borer or leaf-hopper (in one case both) of different species from those already here, is sufficient reason for the circular letter which plantation agents sent their Managers in this connection a short while ago. It must not be forgotten that there are other insect enemies to the sugar cane equally as dangerous as those we have already, if not more so. Only the most rigid inspection of newly intro-

duced consignments of every variety of plant life by competent entomologists armed with the authority of our Territorial laws, can prevent new insect enemies to our agricultural industries from being introduced into the Territory. Fortunately, the Government has in Inspector Craw the right man in the right place, but even with all the care and earnestness which he gives this special work, there is no knowing but that at some time or another in the future a new insect pest, which will prove as serious to our cane fields as did the leaf-hopper, may be surreptitiously or accidently introduced. The agricultural interests of the Territory and particularly those of this Association, must not therefore expect that our entomologists can either prevent the introduction of new pests any more than it can be expected that in every instance a pest, after once having been introduced and established, can be wiped out at short notice, if at all.

The past and present work of Mr. Koebele has continued in the direction of endeavoring to exterminate the insect pests of this Territory by means of the introduction of beneficial insects, but it must be apparent to all that it takes time and in fact years to absolutely control a great many of such pests, more particularly when the true enemy which nature has provided is not yet known. Mr. Koebele has been introducing beneficial insects into the Territory for years past. Many of these apparently did not establish themselves, but it is very interesting to note that some of them continue to turn up every year, showing that, owing to their natural laws of increase, years may elapse before they appear in numbers after their introduction. As a consequence nearly every year, one or more of these beneficial insects is found for the first time at large and in numbers, although the species may have been imported many years before it was thus seen. It may be that many of the beneficial insects introduced to prey on the injurious insects in our cane fields may yet turn up in sufficient numbers to do the work for which the species were introduced. Your Committee dwells on the subject to point out the necessity of patience in order to ascertain the results of the work done. Unless all conditions of insect life are favorable, good results cannot be obtained in a short period of time.

INSECTARY.

The Division has already gathered together numerous insects, beneficial and injurious, that affect the agricultural industries of these islands. These have been classified and identified and placed in cabinets at the Station, not only for the reference of our entomologists, but also for the inspection of any of the Managers who may visit the Department. Our entomologists will always be glad to receive any strange insects

observed by the Managers, or those working under them, especially any such that may be found in the cane fields. The entomologists desire a complete collection of all insects, not only those injurious to cane and those which are beneficial, but also of those that are habitually found in the fields, or even accidentally occur there.

PUBLICATIONS.

During the year the following parts of Bulletin I, dealing with "Leaf-hoppers and their Natural Enemies," have been published, viz.:

Bulletin No. 1. Part VII, by O. H. Swezey.
Bulletin No. 1. Part VIII, by R. C. L. Perkins.
Bulletin No. 1. Part IX, by G. W. Kirkaldy.
Bulletin No. 1. Part X, by R. C. L. Perkins.
Introduction, by R. C. L. Perkins.

The above parts conclude the 1st Bulletin of this Division.

For further and full details of the work of this Division and of its staff, you are referred to the Director's Report.

DIVISION OF PHYSIOLOGY AND PATHOLOGY.

ORGANIZATION AND STAFF.

During the year just past there have been no changes in the organization of the Division. The number of officers remains the same, and their duties have not been changed. It became evident to the director that after a period of maximum activity extending over a few years, the work of the division must thereafter necessarily be less urgently required by the planters. It seemed to him that the staff already gathered was sufficient, if utilized at its maximum efficiency, to cope with the work presented, and that it would be better to proceed on these lines than to bring together a larger staff which would ultimately have to be cut down. The year has been one of active work and some of its results are laid before the Association in the accompanying bulletins.

BUILDINGS AND CONSTRUCTION.

No new buildings have been added to the equipment of the Division during the past year; but the equipment of the buildings already secured has been materially increased in efficiency. The building at the experiment plot at the corner of Alexander and Bingham streets has been remodeled so as to be suitable for those investigations which are necessarily undertaken in the very presence of the cane at the experiment plot. A dupli-

cate of the microscopic room of the main building has been carried out on a small scale. Sinks, tables, closets, etc., have also been supplied. It is unnecessary to specify the numerous final touches that have been given to much of the apparatus of the main building. It will be sufficient to say that the equipment is now in good running order and is proving sufficient for the work presented.

PUBLICATIONS.

The following are the publications of this Division for the past year:

Bulletin No. 4, entitled "Some Elements of Plant Pathology," 46 pages, with 29 original illustrations in the text and 3 original plates.

Bulletin No. 5, entitled "Fungus Maladies of Sugar Cane," 225 pages, with over 100 original illustrations and six colored plates.

Circular No. 2, entitled "Bordeaux Mixture," with reference to its application, 7 pages and 1 illustration.

Circular No. 3, entitled "Root Disease," 2 pages and 1 illustration.

A bulletin on "Rind Disease" is also in course of publication.

EXPERIMENTAL WORK.

During the year the experiment plot at the corner of Alexander and Bingham streets has been made to do good work in the service of the planters. The experiments have been confined largely to testing the effects of fungicides on planted cane cuttings. Many of the results of these experiments are laid before you in the bulletins of the Division herewith presented. It will be recollected that in the previous annual report of your Committee a program of future work of this Division was set down. It will be well, therefore, if we go over this program, item by item, and point out the extent to which this program has been realized during the past year.

1. Root Diseases of Cane. The root diseases of cane have been carefully inquired into during the year, and some interesting and useful results have been obtained. The nature of these diseases is now so well understood that the principal remedial measures that may be taken are known. It is unnecessary to go into the details at this point, as the matter is fully dealt with in Bulletin No. 5 of this Division. All the matters mentioned in the program have received attention. Cultures of the fungi have been studied. The question of soil treatment for these diseases has been gone into and settled, and the effect of sunning, liming, drainage, and burning are all dealt with in the bulletin mentioned.

2. Colored Illustrations of Diseased Cane. Colored sketches of a number of the diseases of cane have been made, and we are now in a position shortly to prepare the originals for plates. Six such plates have already been prepared and are now being printed. It is expected that these will be ready for inclusion in the bulk of the edition of Bulletin No. 5. These six colored plates deal mainly with the effects of various rots on planted cane-cuttings.

3. Raising Seedling Cane, and Testing the Same as to Immunity. Very little has been done along these lines by the officers of this Division. Full mention is made elsewhere of the results obtained by the Division of Chemistry and Agriculture. A number of the seedlings which have been produced by the Division of Chemistry and Agriculture have been turned over to this Division in the shape of cuttings to be planted. These cuttings have been planted and are coming on well. They will be examined and tested from time to time by the officers of this Division and reports will be made upon the results.

4. Immunity Test at Plantations as Well as at the Experiment Station. It is too early to realize this part of the program. In course of time this important work can commence at some of the Substations which are being established on plantations in the various districts.

5. Bulletin on Testing Varieties as to Resistance. This bulletin has been prepared. It does not, however, appear as a separate bulletin, but is one of the secions of Bulletin No. 5.

6. Pure Culture Work on all the Cane Fungi to Ascertain all Possible Spore-Forms. Considerable work of this kind has been done. This work has been largely in charge of Mr. L. Lewton-Brain, the assistant director, and the results of his work will be embodied in future bulletins.

7. What Strength of Bordeaux Mixture will Cane Stand? This question has been largely answered by the experiments of the year. The results of the tests are presented in Bulletin No. 5.

8. Liming Cane. Experiments have been carried out in liming cane. No beneficial results have been thus far noted. The experiments are being continued.

9. The Use of Molasses in Bordeaux Mixture. The use of molasses in fungicides, especially in connection with the Bordeaux Mixture, is not a new thing. For many years a formula has been in existence, and a mixture has been more or less in use, which included some form of molasses. The claim made for this formula is that the mixture is more adhesive. The formula has been designed for use in spraying plants, and no attention was given by its propounders or users to the use of it as a soak for seed. During the year a number of experiments have been made with a Bordeaux Mixture prepared with molasses. The fungicide has proved itself to be efficient, but

at the present time its advantages are still a subject of inquiry. Cuttings dipped in these mixtures (various strengths have been tried) appear to dry quite as quickly as when they are treated in a similar manner in the ordinary Bordeaux Mixture. Furthermore, the mixture seems to adhere to the cane quite as well, to say the least, and it is believed that cuttings dipped in this mixture and then dried would stand handling and transportation better than cuttings treated in simliar strengths of the ordinary Bordeaux Mixture; but, as before remarked, the relative value of these mixtures is still a subject of inquiry. It appears that the island molasses is so different from that which has been previously used in preparing molasses Bordeaux as to require wholly different proportions in the mixture. A number of formulae have been tried. The cuttings are now in the ground, and the results will be made public as soon as they are definitey ascertained.

10. Fungus Fauna of Hawaiian Cane. This is a subject requiring a treatise in itself, and it will be some time before a complete flora Hawaiiensis of this kind can be completed; but good progress has been made, as will be seen by glancing over the published bulletins of the Division. The correspondence which has been carried on with the plantations includes notices of other species than those dealt with in the bulletins. It will therefore be seen that substantial progress has been made with this item.

11. Catalog of Cane Diseases of Fungus and Microbe Origin. This item differs from the preceding, in that it would include only those organisms known to be deleterious to the cane. From this it follows that even better progress has been made with this item than with the previous one.

12. Summarizing the Cane Disease Literature of Other Countries. No specific manuscript on this subject has yet been produced, but the material for such a contribution has been accumulating at a rate which is well indicated by the notes on previous items of this program. A library is being accumulated, due consideration being given in all cases to the works already assembled by the two older Divisions of the Station.

13. Comparative Anatomy of a Resistant Variety, e. g., Yellow Caledonia. This is an important item in the program. In spite of this fact, however, it has not been possible to do much with it, because the study of the comparative anatomy of a resistant variety involves a general knowledge of the anatomy of all varieties. It is therefore necessary, first of all, to know the normal constitution of cane. A beginning has been made in this work, and the amount of material that has been brought to the publication stage is clearly defined in the various bulletins of the Division, some of which contain what are probably the most reliable figures extant, representing the structure of normal cane. Attention has been previously called

by the director of the Division in a pointed manner to the necessity of understanding more about the constitution of healthy, normal cane, and it does not require more than plain common sense fully to understand that a thorough knowledge of disease can only exist after the acquirement of a thorough knowledge of health. In other words, to understand a diseased cane plant, we must first of all understand the healthy plant. This is the logical and only strictly scientific method of procedure. We all understand, however, the necessity of applying to the present conditions of the cane industry of Hawaii all the scientific information that is available through the officers of the Experiment Station, and officers frequently put aside scientific investigations which they clearly see will be ultimately necessary in order to give to the planters the benefit of what science can already say in the way of inferences and deductions from facts ascertained by the study of plants other than cane. As before intimated, the subject is a very large one. In all probability the careful investigation of a single healthy cane plant would fully occupy a large staff for several years. The work of such a staff would consist in a careful examination of all parts of the plant, an accurate charting of all the tissues and a physiological examination of all the different activities that occur during the life of a plant from seed to maturity. The subject is so large and the need of this knowledge is so great that it may not be out of place to suggest that the different cane experiment stations of the world might, by coöperation, bring this material into published form in a much shorter time than is possible in any other way. For instance, the different stations, while not binding themselves to refrain from any investigation called for by their special needs, might agree each to take one part of a standard cane variety and devote to that part such of their investigators' time as can be spared for this purpose, one station taking the leaf, another the root, another the stalk, another the inflorescence, and so on. It really seems as if a very simple understanding on this matter might result in considerable good, and while it is easy to imagine difficulties that might prevent the consummation of such a plan, it certainly would not involve any great expenditure of energy or time or money to ascertain the opinion of other cane experiment stations. It is needless to say that the knowledge of cane gained in this way would be of equal use at all the stations, regardless of their position or local conditions.

14. Anatomy of a Seedling Cane. This item has been sufficiently alluded to in what has preceded.

15. Structure of the Healthy Cane-Root. A certain amount of work on the healthy cane-root has been done in connection with the bulletins on root disease. Figures and discussions in Bulletin No. 2 by Mr. L. Lewton-Brain show this to be the case.

16. Structure of the Cane-Seed. Studies of this nature have been made. The figures that have been prepared and some of

the information that has been secured are presented in Bulletin No. 4.

17. Structure of the Cane "Eye." Comparatively little has been done with this, in spite of its being one of the important items of the program.

18. The Fiber in Health and Disease. Illustrations and discussions in the various bulletins indicate that a considerable amount of study has been given to the cane-fibre and that new information has been obtained with regard to its structure, and a few items of information have been added as to its appearance and condition in disease.

19. Bulletin on Gumming. This bulletin has been prepared and has appeared as Bulletin No. 3. It gives all the information to date; except that the director of the Division has called our attention to a simple detail of considerable importance, in testing cane for gumming. He has been informed, and his experience leads to him to believe that the information is reliable and of practical value, that the steaming of cane-cuttings containing small quantities of gum enables the inspector to detect the gum with greater certainty than would otherwise be possible. The heat of the steam, by expanding the air and liquifying the gum, causes it to ooze out more copiously at the ends of the fibres, so that in the subsequent inspection it is more readily seen.

20. Introduction of New Varieties. Work of this kind falls more particularly to the Division of Chemistry and Agriculture, as does the production of hybrids. The officers of that Division have assembled methods and apparatus that are admirably suited to the purpose and are producing large numbers of hybrids. Steps have been taken to invent a more practical method of cross-fertilizing canes than has been hitherto invented, and it is believed that the apparatus which is being assembled will be practical in its operation.

22. Why are Some Canes Infertile? No very great amount of special inquiry has been made in this direction, but a number of observations have been made incidentally in connection with an examination of the fertilization of Hawaiian cane and the amount of seed these produced by normal fertilization. These facts are alluded to and illustrated in Bulletin No. 4.

23. Inoculation Experiments with Bacterial Diseases. No experiments of this kind have been made.

24. Inoculation Experiments with Species of Cercospora. A number of inoculations have been made, and the results are being carefully watched and will be reported upon.

25. To What Extent, if at all, is the Trichosphaeria (Rind Disease) Independent of Wounds? No inquiries of this kind have been made.

26. Rotation of Crops. No experiments of this nature have been made by the Division; but during the inspection of plantations a considerable series of observations has been made, and

the results of these observations are being constantly used in connection with the correspondence of the Division. They are also alluded to in some of the bulletins.

27. Water-Cultures and Drawings of all Sorts of Spores, and Their Mycelium. Very few opportunities of this sort are lost, and there has gradually accumulated in the archives of this Division a considerable amount of material under this head. Some of it appears in the shape of illustrations in the bulletins; the rest is on file and will be utilized as occasion arises.

28. Yeasts as a Cause of Cane Disease, or as Connected with Disease. Very little has been accomplished with this item. However, a number of allusions to the subject occur in the published bulletins.

29. Nematode Diseases of Cane. A number of nematodes have been examined from various plantations on a number of the islands. A considerable number of new species have been discovered. The descriptions of these species appear in Bulletin No. 5, where also is to be found a full discussion of their relation to the diseased condition of cane.

30. Spraying Experiments with Spores of Trichosphaeria Sacchari (Rind Disease) on Young Cane, Etc. No spraying experiments of this kind have been made.

31. Sawn Cuttings and Other Methods of Preparing Cane. A number of experiments have been made in the preparation of cuttings by the use of saws and other tools. These are reported on in Bulletin No. 5. Some of the results are very striking.

32. Origin of the Internal Nourishment of the Sprouting Cane Bud. A critical experiment has been made in connection with this subject, and the results are reported in Bulletin No. 5.

33. The Chemical, Physical, Biological Cause of the Red Color in the Tissues of Diseased Cane. No further information has been forthcoming under this head.

34. What is the Actual Length of the Destructive Portion of the Life History of Trichosphaeria Sacchari (Rind Disease) and Other Species? This item remains untouched; as does.

35. Can Plants be Made to Absorb Fungicides, and, if so, with What Effect?

It will therefore be seen that, in spite of the formidable nature of the program presented in the last annual report, nearly all the items have received attention, and that the information obtained as the result of these investigations has been to a large extent embodied in the bulletins of the Division. You will therefore be in a position to judge for yourselves the nature and value of the results.

Further details of the work accomplished by this Division during the past year will be found in the Director's Report.

In conclusion, your Committee wishes to express its appreciation of the excellent work performed during the past year by the Directors of the several Divisions. Since its reorganization the Experiment Station has issued numerous Bulletins of such

originality and of such value to the sugar industry in general that the Station, by reason of the work of its several departments, is readily conceded to be ahead of any other similar institution, by scientists and sugar producers in other parts of the world. We are fortunate indeed in having the work of our Station under the direction of such able men. The Association, however, is unfortunate in this respect that, before its next annual meeting, the services of Dr. Cobb, the Director of Plant Pathology and Physiology will have terminated under the special agreement made with him at the period of his engagement. Dr. Cobb is to take charge of the new division of Crop Technology in the U. S. Department of Agriculture. After his departure, Dr. Cobb will no doubt continue his interest in the Station, and keep in touch with his successor, so that many of the experiments inaugurated by him to ascertain the nature and cause of the diseases of sugar cane may be brought to a satisfactory conclusion.

Your Committee has not overlooked the work performed by the staff of the Illustrating and Business Departments. The services performed by the former have been of a high order, and those by the latter, under the immediate superintendence of Mr. Eckart, have been very satisfactory.

Your Committee wishes the Managers of plantations in the Association would always bear in mind that the very purpose of the Station is to serve them, by aiding in the solution of their difficulties, by removing from their shoulders some of their burdens and by helping them to answer some of the many questions that daily confront them. Suggestions as to the most useful and urgent work for the Station to undertake, and frank, helpful criticism of work done, are invited by the several Directors.

Respectfully submitted,

W. M. GIFFARD,
Chairman,

E. D. TENNEY,
E. E. PAXTON,
Committee in charge of Experiment Station.

Honolulu, October 30th, 1906.

APPENDIX I.

REPORT OF THE DIVISION OF AGRICULTURE AND CHEMISTRY.

To the Experiment Station Committee of the Hawaiian Sugar Planters' Association.

Gentlemen: Herewith I beg to submit a report on work of the Division of Agriculture and Chemistry of the Experiment Station for the year ending September 30th, 1906.

LABORATORY WORK.

GENERAL ANALYTICAL WORK.

The total number of analyses completed in the laboratories was 1935, or a gain of 30 per cent. over that of the preceding year. These analyses may be summarized as follows:

Fertilizers, complete	285
Nitrate of soda	31
Sulphate of ammonia	1
Fishscrap	4
Bonemeal	8
Tankage	13
Bat guano	1
Rock guano	2
Superphosphate	1
Double superphosphate	1
Sulphate of potash	1
Fertilizers, redeterminations	76
Sheep manure	1
Soy beans	1
Soils, Aspartic Acid Method	96
Soils, Agric. Method, complete	18
Soils, Agric. Method, partial	33
Soils, Mechanical Analysis, complete	32
Soils, Mechanical Analysis, partial	12
Sugars, polarization	462
Bagasse	3
Molasses	8
Molasses, residues from fermented	2
Cane juices	379
Cane fibers	75
Cane gums	2
Syrup	1
Mud press cake	3
Ash from molasses and bagasse	2
Scale from evaporators	2
Water	11
Determinations, special investigations	96
Determinations, investigations of molasses	243
Determinations, solubility of lime phosphate	20
Miscellaneous determinations	9
Total	1,935

FERTILIZER ANALYSES.

Samples received from Plantations:

Complete fertilizers	260
Bonemeal	7

Tankage	13
Fishscrap	4
Nitrate of soda	30
Bat guano	1
Total	315
Samples received without guarantee	32
Samples received below guarantee	69
Rebate on 69 fertilizers below guarantee	$4,096.95
Rebate on total fertilizers, calculated	4,560.20

The total number of fertilizer samples received by the laboratory during the past year falls considerably short of the number received during the preceding year, there being a difference of 138 samples. The following figures show the number of samples submitted to the Experiment Station during the past seven years, together with amounts of rebate on the same:

Fertilizer samples received:

1900	75
1901	189
1902	229
1903	368
1904	333
1905	453
1906	315

Difference between valuation of Manufacturer and Experiment Station:

1900	$ 12,000
1901	11,000
1902	9,000
1903	4,900
1904	3,089
1905	5,635
1906	4,560

Average rebate per fertilizer as shown by analysis of samples:

1900	$ 160.00
1901	58.20
1902	39.30
1903	13.32
1904	9.28
1905	12.44
1906	14.47

WEEKLY MILL REPORTS.

As during the preceding year tabulated statements of weekly mill reports were issued regularly during the year just closed. Up to September 30th, 1906, 41 statements were sent out by the

Division, comprising reports from the following plantations and mills:

Hakalau Plantation Co.
Hawaii Mill Co.
Hilo Sugar Co.
Honokaa Sugar Co.
Honomu Sugar Co.
Kohala Sugar Co.
Onomea Sugar Co.
Olaa Sugar Co.
Paauhau Sugar Plantation Co.
Pacific Sugar Mill.
Pepeekeo Sugar Co.
Waiakea Mill Co.
Hawaiian Sugar Co.
Kekaha Sugar Co.
Koloa Sugar Co.
Lihue Plantation Co.:
    Hanamaulu Mill.
    Lihue Mill.
McBryde Sugar Co.
Hawaiian Commercial and Sugar Co.
Maui Agricultural Co.:
    Haiku Mill.
    Paia Mill.
Pioneer Mill Co.
Ewa Plantation Co.
Kahuku Plantation Co.
Oahu Sugar Co.
Waialua Agricultural Co.
Waianae Company.

FIELD WORK.

SHIPMENT OF CANE CUTTINGS TO THE PLANTATIONS.

Approximately fourteen tons of seed cane from various varieties were sent to the plantations of the Association during the year, the largest part of it going to the variety sub-stations. This quantity of planting material was divided as follows:

Variety.		Boxes.
Barbados	5	25
"	8A	24
"	147	28
"	156	29
"	208	24

"	244	25
"	306	24
Demerara	115	29
"	116	28
"	117	34
"	1135	25
"	145	24
"	74	23
Queensland	1	21
"	4	7
"	7	29
Moir's White		28
Cavengerie		7
Tiboo Merd		17
Rose Bamboo		23
Yellow Caledonia		9
Striped Singapore		10
La. Purple		5
Big Ribbon		5
Lahaina		5
Total		533

PROPAGATION OF SEEDLING CANES.

During the tasseling period of 1905 the Division repeated its efforts of the previous season in the endeavor to produce seedlings from Hawaiian grown seed. Between the dates of Dec. 6th and Dec. 28th, 1905, 5608 seeds germinated in the propagation boxes, yielding 5134 plants for setting out in the Experiment Station field.

Following the experience of the Division during the tasseling season of 1904, the success attending the germination of Hawaiian grown seeds in 1905 surpassed our expectations. This difference between the results of the two periods may be attributed to the following causes:

1. During the time the canes were in flower in 1904 high winds and excessively wet weather prevailed, the majority of the tassels being blown to pieces before the flowers were sufficiently matured to permit pollination and the formation of seeds. These conditions did not obtain to any serious extent in the winter of 1905.

2. In 1904 only a small number of canes other than Lahaina were in tassel simultaneously with the latter variety. The chances of cross-fertilization were therefore correspondingly small. In the winter of 1905 a large area of varieties, about forty in all, situated immediately to windward and bordering on a Lahaina field, were in flower.

A very interesting observation with respect to the influence of

adjacent varieties on the fertility of Lahaina seeds was permitted during the last season. In the Station field there were two different areas under Lahaina cane, one being directly to leeward of the forty varieties mentioned during the prevailing northeast trades, and the other to leeward of the same varieties only during the spasmodic northwesterly winds. From the former area under Lahaina 471 fertile seeds were obtained, and from the latter area only 60, notwithstanding that a greater number of tassels were taken from this particular locality than from the other.

The number of seeds germinating, the varieties from which they were obtained and the number of plants successfully raised from the lot, are shown in the following statement:

Parent Cane	Number Germinated	Number Planted in Field	Percentage Saved of the Total Number Germinated
Lahaina	531	500	94.2
Rose Bamboo	24	23	95.8
Yellow Bamboo	747	688	92.1
Ko Kea	130	104	80.0
Manulele	1	1	100.0
Pilimai	1	1	100.0
White Mexican	406	390	96.1
Mexican Bamboo	24	19	79.2
Striped Tip	90	80	88.9
"Unknown"	248	233	94.0
La. Purple	48	39	81.3
Striped Singapore	38	27	71.1
Tiboo Merd	5	5	100.0
Cavengerie	1	1	100.0
Gee Gow	32	31	96.9
Dark Colored Bamboo	26	14	53.8
Demerara No. 74	8	8	100.0
Demerara No. 95	120	113	94.2
Demerara No. 115	48	47	97.9
Demerara No. 116	1409	1305	92.6
Demerara No. 117	398	370	93.0
Demerara No. 1135	844	767	90.9
Demerara No. 1483	24	24	100.0
Barbados No. 5	103	91	88.3
Barbados No. 208	24	18	75.0
Barbados No. 306	108	92	85.2
Queensland No. 1	8	8	100.0
Queensland No. 4	123	103	83.7
Queensland 8A	26	19	73.1
Altamatti	13	13	100.0
Total	5608	5134	91.5

In addition to the seedlings enumerated above, 98 plants from unknown parents were planted in the field, making a total for the season's work of 5232 seedling canes.

The painstaking care bestowed upon this work by Messrs. Clarke and Lougher of this Division deserves special commendation and the thanks of the Experiment Station is also due your Chairman, Mr. Giffard, and Mr. H. A. Baldwin, through whose kindness quantities of suitable soil were obtained for seed bed purposes.

Of the 279 plants raised from the West Indian seed imported in the fall of 1904, 37 have shown sufficient promise to warrant cropping tests in the Station field. Small plats were laid off and planted with a number of these varieties during the latter part of July and the first part of August of this year; the remainder will, by the summer of 1907, furnish sufficient planting material for starting plat tests at that time. Those with which plat experiments are already under way are the following:

Variety	Parent Cane	Seed Germinated	Average Wt. per Foot, Ounces	Analysis of Juice		
				Brix	Sucrose	Purity
Hawaii No. 8	D. 99	Dec. 1904	15.3	18.21	17.1	93 90
" " 9	B. 306	Feb. 1905	11.6	18.37	16.9	92.00
" " 11	D. 115	" "	12.6	18.27	16 5	90.31
" " 29	D. 115	" "	11.5	17.19	15.6	90.75
" " 34	" "	" "	9.9	17.59	16.4	93.23
" " 35	" "	" "	12.5	17.99	15.3	85.05
" " 39	B. 306	" "	12.1	17.79	16 1	90.50
" " 54	D. 99	" "	8·5	19.01	17.1	89.95
" " 55	D. 115	" "	12.2	17.49	15.9	90.91
" " 56	T. 230	" "	12.0	17.19	15.8	91.91
" " 57	D. 115	" "	11.3	17.96	16 7	92.98
" " 66	" "	" "	9.5	17.90	15.8	87.76
" " 70	" "	" "	11.1	19.12	17.5	91.51
" "112	" "	" "	8.1	20.68	19.3	93.32
" "132	T. 230	" "	13.7	16,77	14 8	88.25
" "139	D. 99	" "	12.5	18.89	17.5	93 06
" "140	D. 115	" "	11.7	19.19	17.6	91.71
" "178	" "	" "	14.3	18.75	16.6	88 53
" "190	" "	" "	12.4	17.98	16.1	89.54
" "203	" "	" "	12.5	19.15	17.3	90.35
" "232	T. 230	" "	13.1	17.26	15.6	90 38

Seed cane from all of these varieties is being grown for distribution and by the summer of 1908 there will be sufficient planting material on hand for supplying all of the plantations with a liberal quantity of the same. The new seedlings will then be subjected to careful tests under the many different island conditions.

It is advisable that none of these new varieties leave the Experiment Station for plantation trial until they have shown promise with respect to the salient characteristics which are required in canes for commercial cropping. Many seedlings, of large size and apparently perfect as far as their field characters are concerned, are found to be worthless as sugar producers, containing as they do an abnormally low percentage of sucrose in their juices. If one of these canes only contains 8 or 9 per cent. of sucrose at the Experiment Station it is evident that this same cane is not apt to prove a success in other communities and under other conditions. The quality of the juice would be too far below any of the standards in the different plantation districts to warrant the expectation that a change in the environment of the variety would place it on a footing with the established canes of those other localities. When an irrigated seedling proves a complete failure under the favorable climatic and soil conditions of the Experiment Station, it is safe to assume that it is not going to prove superior, if sent to the plantations, to such varieties as Lahaina, Yellow Caledonia, Rose Bamboo, Demerara 117 and Yellow Bamboo. The fact that of the imported canes grown at the Station from time to time, a number have done exceedingly well in Honolulu and made an indifferent showing under other island conditions of a radically different nature and *vice versa,* is not contradictory to this assumption. It would be hard to conceive of a wider difference between the conditions which obtain on the highest cane lands of Kau and those which exist at the Experiment Station. Experience showed that Yellow Bamboo before the time of the leaf-hopper surpassed all other varieties on the high elevations at Pahala, while at the Station this cane when compared with others was a relatively poor producer, notwithstanding the minimum average of its plant and ratoon yields amounted to somewhat over five tons of sugar to the acre. It was not a failure at the Experiment Station therefore except in a relative sense, and in fact it will be conceded that five ton yields with Yellow Bamboo would be considered very good in Kau.

No seedlings will be rejected in the selections made at the Station simply because they fail to give yields approaching those of Lahaina and other standard canes under Honolulu conditions, but only in those cases where the plants show little or no merit with respect to the many characteristics which are required of suitable varieties. All of the canes which remain after the various selections at the Experiment Station will be sent to each of the separate plantations on the different islands where a further selection will be made by the respective plantation managers, under their particular conditions.

Beginning with the summer of 1908 it will be possible each year to send a fair number of promising seedlings to the plantations. The first lot will comprise twenty or more varieties from

the seeds germinated in the winter of 1904-1905, making the interval between the germination of the seeds and the distribution of the varieties (to plantation nurseries) three and one-half years. During this period, not only will enough planting material have been obtained to supply all of the plantations on the islands, but the plant cane from small plats will have been harvested giving the indicated cropping value of the various varieties at the Station.

In addition to the Hawaiian seedling canes which will be planted in small plats during 1907, the following imported canes will also be tested in the same manner:

Couve 27,
Striped Mexican,
White Mexican,
Mexican Bamboo,
Innis 131,
Badila,
Hybrid Footiogoo.

PLAT EXPERIMENTS HARVESTED IN 1906.

The plant cane of the fertilizer experiments started in 1904 was harvested during the past season, but it was deemed advisable, owing to the small reliability which may be placed upon the results from one crop, to defer reporting on the same until the ratoons are cut in 1908. The average figures yielded by the plant and ratoon crops will at that time be reviewed in a bulletin bearing upon the experiments in question. The plan of the tests was given in some detail in the report to the committee at the close of the year 1904. At this place it may be well to state that with the harvesting of the ratoons from these plats, the Station field will be given over entirely to the propagating and testing of imported canes and Hawaiian grown seedlings.

Thirty-eight plats of varieties were cut and tested during the year just closed and the data derived from the same were published in Bulletin No. 17 of the Division.

Experiments on irrigation and fallowing were discontinued during the early part of 1906 to make room in our limited field area for the large number of seedlings awaiting transplanting from pots. These experiments, which were temporarily abandoned, will in time be taken up by the Sub-stations of the Association and carried out on a larger scale and under more satisfactory conditions.

PLANTATION SUB-STATIONS.

EXPERIMENTS OF THE WAIAKEA MILL CO. AND THE LAUPAHOEHOE SUGAR CO.

A small experiment area, devoted to fertilizer experiments, on each of these plantations, was harvested in the early part of the

year. As these stations were started prior to the drawing up of any general and systematic plans for conducting sub-station work on the plantations, and dealt with questions which were chiefly of local interest to Waiakea and Laupahoehoe, no bulletin was published by the Division concerning the same.

SUBSTATIONS TO BE HARVESTED IN 1907.

These stations dealing with fertilization are located on the following plantations:

Hilo Sugar Co.
Paauhau Sugar Plantation Co.
Hawaiian Commercial and Sugar Co.
Kohala Sugar Co.

On each of the first three plantations there is one sub-station, and on the lands of the Kohala Sugar Co. two sub-stations, one of the latter being irrigated and the other unirrigated.

The sub-station started at Ewa in behalf of the plantations on Oahu is being conducted by the Manager of the Ewa Plantation Co. as an independent station. * * *

Complete chemical and mechanical analyses of the soils of the sub-stations have been made and following the harvesting of the cane from the different experiment areas a careful study of the action of fertilizers on soils of known chemical and mechanical composition will be permitted. In this way the value of fertilizer recommendations based upon the analysis of soils by the Aspartic Acid Method will be put to a practical test and the limitations of such soil analyses will be determined. If the method is found inadequately reliable for indicating soil needs with regard to fertilizers, steps will be taken to perfect laboratory measures for gauging fertilizer requirements on a safer basis. In this way the data derived from these investigations may be put to a very important and general use. Aside from the general value of these experiments, information of special importance will naturally be obtained by the coöperating plantations undertaking the tests.

The results derived from these several sub-stations will be published in the form of a bulletin in 1907. * * *

GENERAL OBSERVATIONS IN CONNECTION WITH SUBSTATION WORK.

The carrying out of field experiments under the coöperative management of the plantations and the Experiment Station has thus far been in the initiative stage and a number of difficulties have been encountered which could not readily have been foreseen. Following certain small modifications in the plans governing the laying out of plantation experiment areas, and with the free and mutual interchange of views between the plantations

and the Experiment Station concerning the various phases of the work under particular plantation conditions, these few difficulties may in future be readily eliminated and the success and value of the work fully assured. * * *

ADDITION TO EXPERIMENT STATION FIELD.

On June 1st, 1906, the lot on Wilder Avenue, mauka of the main field of the Experiment Station, was leased by the Planters' Association for experiment purposes. On this area of approximately one acre, seedling canes will be grown to furnish planting material for plat tests and for distribution.

BULLETINS OF THE DIVISION.

Four bulletins were published by the Division of Agriculture and Chemistry during the past year as follows:

Bulletin No. 16: The Influence of Stripping on the Yields of Cane Sugar.
Bulletin No. 17: Comparative Tests with Varieties of Cane.
Bulletin No. 18: Hawaiian Waste Molasses.
Bulletin No. 19: Lysimeter Experiments.

BUSINESS OF THE STATION.

This department has been conducted as heretofore under the general management of the Director of the Division of Agriculture and Chemistry. Mr. C. H. McBryde, the station cashier, has rendered the same excellent services as formerly and his capable and systematic control of the office affairs has left nothing to be desired.

STAFF OF THE DIVISION OF AGRICULTURE AND CHEMISTRY.

No changes in the Staff of this Division have taken place during the year just ended, and the gentlemen of the laboratory and field departments have rendered the same efficient assistance to the Division as in former years.

Respectfully submitted,

C. F. ECKART,
Director, Division of Agriculture and Chemistry.

Honolulu, T. H., October 10th, 1906.

[APPENDIX II.]

REPORT OF THE DIVISION OF ENTOMOLOGY.

To the Experiment Station Committee of the Hawaiian Sugar Planters' Association.

Dear Sirs: The work of the Division of Entomology for the past year may be considered under five heads: (1) Work of the traveling entomologists; (2) Distribution of beneficial insects and results; (3) Inspection of Plantations; (4) Publications, and (5) Miscellaneous subjects. These subjects will be considered in order as above.

WORK OF TRAVELING ENTOMOLOGISTS.

In October of last year, Mr. Muir of our staff left for Fiji, his main object being to make a fuller investigation of the Fijian sugar-cane leaf-hopper, a species that very closely resembles our own pest. It seemed probable that some other enemies of the Fijian leaf-hopper might be introduced, which would be likely to attack the one here, the more so as we had previously imported and established certain other Fijian parasites successfully. Moreover, one cannot overlook the possibility, that sooner or later the Fijian cane leaf-hopper may turn up in these islands, in spite of all precautions taken to prevent it. Cane taken from Fiji to Vancouver, as it no doubt frequently is, would always be liable to carry living hoppers, and some of these would be quite likely to fly ashore here, attracted by the strong lights of the city. Mr. Muir has especially noted that, on his return journey from Fiji, both young and fully adult hoppers were found by him on some sticks of cane taken on deck by a passenger going through to Vancouver.

During his stay in Fiji Mr. Muir continued regularly to send such enemies of the Fijian cane-hopper as he considered most important, and was successful in getting several species of parasites over to us alive.

Special attention was given to the minute Stylopid parasite (Elenchus), which we had previously tried to import from Ohio and California, and which in Australia is the cause of a large percentage of mortality in certain leaf-hoppers. After several attempts by myself, which were renewed subsequently by Mr. Muir on his return to Honolulu, we are compelled to believe that this important parasite, which attacks the Fiji cane-hopper so readily, cannot exist on the Hawaiian species. It is, however, proper to say that our knowledge of these parasites is yet of a most rudimentary character, and that under certain conditions the transfer-

ence of the Fijian *Elenchus* to our cane-hopper might after all prove a simple matter. On the other hand, we may state that in North Queensland, where a similar parasite *(Elenchus)* was abundant on several (and sometimes very different) kinds of leaf-hoppers, which infested the grass growing between rows of cane, not a single individual of the cane leaf-hopper was found infested. It is therefore possible that our pest is immune from the attack of these parasites.

A second parasite of the Fijian cane leaf-hopper is a species of *Haplogonatopus,* an ant-like insect, in general habits resembling our well known Fairchild parasite *(Echthrodelphax fairchildii)* of the leaf-hopper. A small number of these reached this country alive, and attacked and were successfully bred on the Hawaiian cane leaf-hopper. Since its introduction specimens have been distributed to several plantations. It would be a particularly valuable species in these islands, in that it attacks fully winged leaf-hoppers, and consequently is carried by these when they fly, and therefore is less liable to be destroyed, wholesale, when fields are burnt over, after the crop is harvested.

The active little ladybird, *Verania strigula,* that is such a frequent and useful inhabitant of Queensland cane-fields, was specially sent from Fiji, as likely to be more readily acclimatized in our insular climate, than those from Australia. Several colonies raised from these Fijian parents have been sent to various parts of the islands.

Several other beneficial insects were sent over by Mr. Muir, notably that very handsome large ladybird, *Archaioneda tricolor* var. *vitiensis.* Of this a number of fine colonies were raised and distributed by the Division, and specimens were further sent to the Territorial Board of Agriculture for further propagation. This ladybird feeds freely on Aphis, mealy bugs, and other pests, and is very voracious

While in Fiji Mr. Muir also investigated the cane-borer *(Sphnophorus obscurus)* which, it had been reported, had decreased in numbers there of late years. It seemed possible to us that some natural enemy might have attacked this pest—that possibly some parasite had become transferred to it from some native weevil. This, however, on close investigation, proved not to be the case, and the borer was found to be at least more numerous than in some of our rather badly affected plantations. It seems probable that in some seasons a large number are destroyed by fungous diseases in the more humid climate of Fiji. In fact, Mr. Muir everywhere noted the great mortality of Fijian insects in general from such diseases.

In July, after a short stay in Honolulu, during which he attended to the beneficial insects sent over by him, and also prepared a large number of specimens collected in Fiji for study, Mr. Muir left for China, with a view to first examining the leaf-

hoppers of that country and Java, and then extending his researches to the cane-borer. In Australia, Fiji, New Guinea and other countries, we know that, as in Hawaii, the cane-borer is an imported species, and its native home is still unknown. If the country from which it has spread can be discovered, it is quite probable that natural enemies will be found there that keep it in check.

Mr. Koebele, who at the time of writing is in Mexico, has been largely occupied in collecting parasites for horn-fly and enemies of general agricultural pests. As these will no doubt be reported on by the entomologists of the Territorial Bureau of Agriculture, who have had charge of his sendings, I need not refer further to them here. Mr. Koebele has, however, continued throughout his researches on leaf-hoppers, and sent over anything that might prove of service to us.

DISTRIBUTION OF BENEFICIAL INSECTS.

(a) *Distribution.*

The distribution of beneficial insects has been continued regularly since the last annual meeting of the Association. After the last inspection of the plantations had been made and the range of the imported parasites was more accurately known, seeing that some of these parasites might be absent in certain localities, I advised the managers (through the agents) to obtain from the Station colonies for distribution to such new fields as might be planted and in which leaf-hopper was evident. I wished to be certain that all the available parasites should be given every opportunity to establish themselves in new areas. The call for these cages of parasites began in May and has continued up to the present time, as new fields have come into condition for receiving them. From May up to date of writing (October 9th) nearly three hundred of these cages have been sent out from the Experiment Station as the managers have called for them, through their agents. In the introductory part of Bulletin I, I again urged the advisability of stocking new fields with parasites, before the leaf-hoppers should become numerous, and suggested various ways in which the managers of plantations might themselves do this, in addition to receiving special colonies of parasites from the Station, when necessary. On many plantations affected by leaf-hopper, the distribution of parasites over new areas has been systematically and thoroughly attended to by the managers themselves in a most praiseworthy manner.

In addition to the egg-parasites of leaf-hopper, numerous colonies of other beneficial insects have been distributed amongst the plantations. Some of these insects are of such a nature that they will only be likely to thrive in certain localities, and therefore the

Foreign Steamer Time Table.

STEAMERS TO ARRIVE.

Date.	Name.	From.
January—		
" 22—	Coptic	San Francisco
" 22—	Sierra	Colonies
" 23—	Ventura	San Francisco
" 29—	America Maru	Yokohama
" 31—	Hongkong Maru	San Francisco
Feb. 1—	Alameda	San Francisco
" 5—	Siberia	Yokohama
" 6—	Miowera	Colonies
" 9—	Moana	Victoria
" 12—	China	Yokohama
" 12—	Korea	San Francisco
" 12—	Sonoma	Colonies
" 13—	Sierra	San Francisco
" 19—	Mongolia	Yokohama
" 20—	America Maru	San Francisco
" 22—	Alameda	San Francisco
" 26—	Nippon Maru	Yokohama
" 28—	Siberia	San Francisco
Mar. 5—	Ventura	Colonies
" 6—	Aorangi	Colonies
" 6—	Sonoma	San Francisco
" 7—	China	San Francisco
" 9—	Doric	Yokohama
" 9—	Miowera	Victoria
" 15—	Alameda	San Francisco
" 15—	Mongolia	San Francisco
" 16—	Coptic	Yokohama
" 20—	Nippon Maru	San Francisco
" 26—	Sierra	Colonies
" 26—	Hongkong Maru	Yokohama
" 27—	Ventura	San Francisco

STEAMERS TO DEPART.

Date.	Name.	For.
January—		
" 22—	Coptic	Yokohama
" 22—	Sierra	San Francisco
" 23—	Ventura	Colonies
" 29—	America Maru	San Francisco
" 31—	Hongkong Maru*	Yokohama
Feb. 5—	Siberia	San Francisco
" 6—	Miowera	Victoria
" 6—	Alameda	San Francisco
" 9—	Moana	Colonies
" 12—	China	San Francisco
" 12—	Korea	Yokohama
" 12—	Sonoma	San Francisco
" 13—	Sierra	Colonies
" 19—	Mongolia	San Francisco
" 20—	America Maru	Yokohama
" 26—	Nippon Maru	San Francisco
" 27—	Alameda	San Francisco
" 28—	Siberia	Yokohama
Mar. 5—	Ventura	San Francisco
" 6—	Aorangi	Victoria
" 6—	Sonoma	Colonies
" 7—	China*	Yokohama
" 9—	Doric	San Francisco
" 9—	Miowera	Colonies
" 15—	Mongolia	Yokohama
" 16—	Coptic	San Francisco
" 20—	Nippon Maru	Yokohama
" 20—	Alameda	San Francisco
" 26—	Sierra	San Francisco
" 26—	Hongkong Maru	San Francisco
" 27—	Ventura	Colonies

* Calling at Manila.

U. S. A. Transports will leave for San Francisco and Manila, and will arrive from same ports at irregular intervals.

points to which they are sent must depend on the judgment of the entomologist, as wholesale distribution would be a useless waste of time and trouble.

(b) *Results of Distribution.*

In March of this year I sent a circular letter to each of the agents of the various plantations, requesting them to obtain from each manager a statement as to the condition of each plantation with regard to leaf-hopper attack, as compared with the same season last year. At this date the egg-parasites, as we were aware, had become very generally spread over the plantations, and in some cases extraordinarily numerous, and it was clear that they should now be making some decided impression on the hopper. The plantations, as evidenced by the replies to the question, "Is the leaf-hopper more or less abundant than at this period last year?" could be divided into three classes: (1) Those showing marked improvement; (2) Those which were little changed, that is at most slightly better or worse, and (3) Those which were much worse.

It is noteworthy that those, in which little change for better or worse was noted, were mostly plantations which were in any case not very badly attacked. Those showing marked improvement were numerous, and represented on all the islands. Many of these were plantations that had previously suffered very badly. In fact there is no doubt that on badly attacked plantations certain of the parasites were able to spread and increase proportionately much more rapidly than on the others. Of those which were much worse than in the preceding year, there was only one very notable case. This report states: "Ever so much more abundant," and a letter of the same period gives details and attributes the outbreak to the dry, warm weather. A special examination of this plantation was made as soon as possible, and it was found that already parasites were present in great numbers; and the damage done was clearly due to a large swarm of leaf-hoppers having suddenly invaded the fields at a time when few parasites were present. Probably in time when the distribution of parasites is everywhere uniform, such outbreaks will become very unusual, or altogether disappear. It is remarkable that two other small outbreaks of leaf-hopper on other plantations are attributed to the "cold, wet weather," or an exactly opposite cause.

As I have quoted the one most striking instance of leaf-hopper increase, I will give an instance of conspicuous decrease. One manager writes: "We feel that the leaf-hopper is not within 50 per cent. of what it was at this time last year. We have some 400 acres of plant cane for the crop of 1907, all of which is being attacked by the leaf-hopper, but it is so far ahead of any plant

cane, which we have had for the past three years that we are very hopeful of the future. Unless these plant fields should be subjected to an extraordinary attack by leaf-hopper during the next two or three months we figure we will obtain an average yield of 9 tons of sugar from the said fields, from the present condition of the cane, where heretofore for the past two or three crops we have not been able to obtain more than 6½ or 7 tons from planted cane, all because of the fierce attacks of leaf-hopper on plant cane fields." An examination by myself of the leaf-hopper eggs in cuttings brought in from these fields showed that fully 50 per cent. of the eggs were already being destroyed by one parasite alone *(Paranagrus optabilis)*. Some managers expressly state that they are certain the improvement is due to the almost invisible parasites, having themselves closely observed their work, while others attribute a decrease to the presence of large and conspicuous predatory creatures, as is very natural, and is no doubt sometimes correct.

In one case I was able myself to make a rather careful investigation of the value of the egg-parasites in the field. This was on a plantation that has always been very badly infested with hoppers, and in a field especially favorable for their increase, owing to its sheltered position and other causes. This field was of young ratoons, and when I first visited it the growth was about knee-deep. Every cane in the field had a flock of mature winged hoppers, which had arrived by migration from other fields, and spread themselves over the cane plants in the very regular manner, that I have elsewhere described. Almost every leaf of every plant had its midrib stuck full of egg-punctures, generally about fifty to one hundred pricks to each leaf. I estimated that in the natural course of events about two thousand young hoppers to each plant would have emerged in this field, from this first egg-laying, if none of the eggs were parasitized, and it is certain that no cane could possibly have withstood the resulting attack. Every plant had it been thrice as large must have been killed. This field was visited three or four times and examined at intervals of a few weeks, and in spite of the vast numbers of eggs, young hoppers were on each occasion very scarce. Later on a sample of egg-punctured leaves was brought to the office; these were placed in a closed jar, and the parasites and leaf-hoppers that emerged were all carefully counted. From this one jar were obtained 3275 parasites and 520 young hoppers, that is to say, 86.3% of the eggs were destroyed and 13.7% produced hoppers, of which in the field no doubt, a considerable number would fall victims to such predaceous insects as were noticed there—spiders, ladybirds predatory bugs (Zelus) and the carnivorous green cricket (Xiphidium). No one acquainted with these facts could doubt that this particular field was

saved from entire destruction by the egg-parasites. This percentage of parasitized eggs is the highest that has come under our notice and is no doubt unusual, the locality, while favorable for the leaf-hopper, being likewise very favorable for the parasite *(Paranagrus)* by which most of the destruction was wrought.

INSPECTION OF PLANTATIONS.

The regular inspection of the plantations has been carried out by Messrs. Swezey and Terry, and the usual reports on each plantation submitted to the agents and managers. These reports deal fully with the entomological situation on the several plantations, at the time, when the inspection is made. The abundance or otherwise of all injurious insects is noted on each plantation, as also are all the beneficial insects, and recommendations as to treatment is given in all cases, where necessary. While these reports should be of considerable value to the plantation managers they are not less so to the entomologists themselves, since their uniform nature renders possible an accurate comparison of the condition of any two plantations, or of the same plantation in different years or seasons.

PUBLICATIONS.

Since the last annual meeting, Bulletin I of this Division, dealing with leaf-hoppers and their natural enemies, was brought to a conclusion on May 1st, when the introduction was published, the following parts having been issued:

Part VII.—"Orthoptera, Coleoptera, Hemiptera." Dec. 30th, 1905. By O. H. Swezey.

Part VIII.—"Encyrtidae, Eulophidae, Trichogrammidae." Jan. 6th, 1906. By R. C. L. Perkins.

Part IX.—"Leaf-hoppers—Hemiptera." Feb. 3rd, 1906. By G. W. Kirkaldy.

Part X.—"Dryinidae, Pipunculidae; Supplementary." March 1st, 1906. By R. C. L. Perkins.

Introduction. May 1st, 1906. By R. C. L. Perkins.

These parts include pp. 207-490 of Bulletin I and plates XIV-XXXVIII with xxxiii pages of introduction and seven figures in the text. A complete index to the Bulletin was drawn up by Mr. Kirkaldy. Many of the plates were admirably executed by Mr. Chambers, and we regret that time did not allow of his making all the drawings.

In the near future it is purposed to publish a brief Bulletin dealing with work in Fiji by Mr. F. Muir, and an account of the cane leaf-roller *(Omiodes accepta)* and other Hawaiian moths closely allied to this, by Mr. O. H. Swezey, and further remarks on leaf-hoppers by Mr. G. W. Kirkaldy.

MISCELLANEOUS.

The ordinary work of the laboratory has progressed satisfactorily during the past year. We have now a fairly complete collection of such insects, as one meets with in the cane-fields, and further a considerable amount of material for a general collection has been got together. The importance to us of a reasonably extensive and accurately named reference collection cannot be overestimated, since we are cut off from access to any complete library or large museum. Frequently, instant information on some special insect is urgent or even indispensable; its scientific position must be made out before such information is possible, yet without a reference collection this is often almost impossible. The working up of collections received is therefore an important part of the laboratory work, and the time that can be given to such work is well spent.

The additions to the library outside the necessary continuance of periodical publications have not been considerable. To avoid buying expensive volumes, for the sake of special articles that must be seen, we have adopted the method of having these articles copied for us at one of the great libraries, according to the arrangement mentioned by me in my last report.

No serious new pest has been observed on cane during the past year, but the small caterpillars found in connection with the "ili-au" disease, are deserving of further observation. It was the opinion of the Pathologist that these caterpillars might be the cause of this curious disease. So far as our researches have gone, it appears that the "ili-au" disease can occur without the presence of these, and in most cases when present they are too few in numbers to cause such marked results on the cane. In other lines we may note the increase to large numbers of a new army-worm, lately introduced, since it was only first observed a few years ago. It is not certain whether this will attack cane, but it will no doubt be injurious to some forage plants. Of other insects the remarkable increase of a large Ichneumon fly parasitic on cutworms, is remarkable, and it is now quite a feature of some of the higher parts of the islands. This beneficial species was introduced by Koebele some time prior to 1900, when I found a single specimen at large in the mountains, while in his company, but it did not become numerous till quite recently.

Respectfully submitted,

R. C. L. PERKINS,
Director, Division of Entomology.

[APPENDIX III.]

ANNUAL REPORT DIVISION PATHOLOGY AND PHYSIOLOGY.

The Chairman of the Experiment Station Committee.

Sir:—The routine work of the office has been carried on without any serious break during the year. The correspondence,—consisting largely of letters in response to inquiries relating to maladies of cane,—has involved the writing of several hundred letters and reports. The total correspondence is at present represented under about five hundred consecutive numbers.

The publications of the year have taken the form of bulletins and circular letters. Of the former two have been prepared, one being a reprint, with the addition, however, of numerous illustrations, of the address delivered at the last annual meeting, and the other a report on root-disease and several other of the more important diseases of cane. Together these bulletins comprise about three hundred pages, and are illustrated with about one hundred and fifty original figures.

Two circular letters have been issued, one on the preparation of Bordeaux mixture, and a second giving accurate information as to the distribution of *Ithyphallus* in the Hawaiian Islands. Correspondence in connection with root-disease necessitated, in the interests of expedition, the preparation of colored photographs of the *Ithyphallus* to accompany letters on the subject, and the preparation of the photographs added considerably to the work of conducting the correspondence. However the use of colors resulted in rapidly accumulating accurate and reliable evidence.

The scientific work of the year is to a considerable extent reflected in the publications mentioned above, though of course much work now in progress has not reached the publication stage. In particular the culture work of Mr. Lewton-Brain, relating to the life history of various fungi, is such that a full account of the results must be left to the future.

A complete and careful record of all such work is kept, and the correspondence of the division always takes its tone from the most recent results of our investigations, even where the results of such investigations are not known outside the Division.

The artistic and publication work of the Division has been superintended by Mr. E. M. Grosse. The high quality of this work speaks for itself. The original drawings and the finished blocks are kept on file in systematic order. A considerable number of colored drawings have been prepared, illustrating diseases of the cane plant. Some of these are in progress of publication, and others are advancing to that stage.

Owing in part to the efforts of the staff of this Division there has been an improvement in the quality of line and half tone

work that can be produced in the Territory for the illustration of scientific bulletins.

A considerable amount of the black and white drawing for the division publications has been done by Mr. W. E. Chambers. All the engraving on wood has also been done by Mr. Chambers. The final preparation of all the blocks used in our text also falls to the same officer. All this work is done with an unusually high degree of skill.

The constituents of the Hawaiian Sugar Planters' Association frequently make use of the Division by means of personal visits. Such calls are always highly appreciated by the officers of the Division. The exchange of ideas on such occasions is highly stimulating.

During the year just past the Director of the Division found opportunity to visit the plantations on the island of Hawaii. The results of this inspection are presented in a report that will soon be published. In addition to this publication, reports were made on each plantation visited, and these separate reports were sent to the agencies representing the plantations for transmission to all concerned. It is the intention to continue these visits of inspection, and it is hoped that during the next year the balance of the plantations may be visited in a similar manner. It is with regret that the Director has found it impossible in the best interests of all concerned to complete these inspections at an earlier date. The material collected during the first series of inspections was so rich that it seemed beyond question best to work it up and place the results on record before going farther. It is hoped that the publication of the reports will fully justify this delay in the inspections.

In order that the results of the visit to Hawaii might be utilized at the earliest possible date on all the plantations of the islands it was decided not to wait until the reports could be printed, but to invite the plantation managers to a lecture descriptive of the facts that had been accumulated as the result of the investigations: Accordingly, the Honolulu agencies of the plantations having first attended the lecture on the subject, invitation was extended to the plantation managers to attend the lecture in the laboratory of the Division at Honolulu. Many of the managers took advantage of the invitation. The lecture was illustrated with preparations and with colored projections produced in one of the rooms of the Division specially designed for that purpose. In this way the spreading of the information accumulated by the officers of the Division has been expediated as much as possible.

It has fallen to the officers of this Division to assist in the inspection of proposed importations of cane from other countries. This has been through the invitation of the Territorial officers in charge of such work. In no case has it seemed best to allow such importations to enter the Territory. All the cases of this sort have been such that to have admitted the cane to the Territory would

have been taking a positive risk for the sake of a very problematical advantage.

Past experience has shown how very risky it is to import plant material indiscriminately, and however many faults may be found with the results of inspection work, not only in this Territory, but everywhere where it is in operation, there can be no doubt that whenever there is an honest effort to do good work the results are eminently satisfactory from the standpoint of the general good of the community. This is especially true of Hawaii, a Territory where the ports of entry are so few that such work can be carried on with comparatively little expense and yet with a comparatively high degree of precision.

A considerable amount of diseased crop material other than cane has found its way to this laboratory from outside sources. This no doubt has been because there is no other organization in the Territory so well equipped to examine material of this kind. The policy of the Division has been, with the approval of the Committee in charge, to extend to correspondents and applicants of this kind every courtesy consistent with the proper conduct of the Division's work. Whenever information could be given concerning pests of crops other than cane without the necessity of a scientific examination, i. e., as the result of previous experience, it has been freely given. In a few interesting cases brief special examinations were undertaken of crops in which some of the sugar plantations were themselves interested. Most cases of this sort have arisen through the agency of public officers located in this Territory, though in some cases private individuals have inadvertently made direct applications.

During the year a number of improvements have been made in the equipment of the Division. The building at the Sub-station at Alexander street has been fitted up as a sub-station laboratory, and connected with the main office by telephone. This has been rendered necessary by the increasing importance of the work at the experiment plots. It has been found of decided advantage that the plots are to the windward of any other cane on this island. The nature of the work at the plot is rather fully described in Bulletin No. 5.

At the main laboratory an inoculation room has been constructed, which though it has not thus far been frequently used, will, it is believed, prove valuable in the future. This room is about five feet square, and is on castors so that it can be moved about the laboratory, or taken to another building if necessary. It is in two pieces: 1, a base of wood, and 2, the building proper, of air tight metal. There are two rooms, one an entry and the other the inoculation room proper. Air is admitted through cotton wool covering the whole of the base and is sent out through a flue in the top of the inoculation room. A draught is created by suction. The interior of the room is painted with glycerine so as to cause floating dust soon to adhere to the walls. Provision

is made for the rapid and convenient cleansing of the interior with water or disinfectants.

Additions have been made to the library and museum during the year. A few necessary books have been purchased, and a very large number of publications have been received from agricultural stations and agricultural departments throughout the world. It is mainly upon these latter publications that we rely for the most recent information on subjects closely related to our work.

A cheap and efficient sunlight enlarging apparatus has been added to the laboratory equipment. It is found better in many cases to enlarge the original photograph in order to get certain effects in the resulting half-tone to be used for publication.

Some of the apparatus of the Division laboratory has received the compliment of being widely copied. The descriptive matter published in the last annual report has been republished in the Journal of the Royal Microscopical Society, England, and, as a result of this and other notices, inquiries have been received from various parts of the world. From information supplied in answer to such inquiries similar apparatus is now either in use or in process of construction in a considerable number of institutions.

I am, Sir,

Yours respectfully,

N. A. COBB,
Director of the Division of Pathology and Physiology.

Dr. Cobb, in presenting the report of the Division of Pathology and Physiology, spoke of the great importance of the inspection of plant importations into the Territory, as a means of preventing the bringing of plant diseases and insect pests, and urged that such inspection be heartily supported and assisted by the members of the Association.

Mr. D. Forbes, chairman of the Committee on Fertilization, thereupon presented the following report:

REPORT OF COMMITTEE ON FERTILIZATION.

To the Trustees and Members of the Hawaiian Sugar Planters' Association:

GENTLEMEN:—The Committee appointed by the President, to prepare a report on Fertilization were Messrs. C. B. Wells, Geo. Chalmers, Wm. Stodart, John Watt and Chairman, D. Forbes—each of these gentlemen representing the Island on which he is located.

That on fertility of soil we are all aware much of the success in raising heavy crops depends, and none more so than that of sugar cane. Twenty or more years ago on the virgin soil of these Islands cane was planted with little or no thought given

to fertilizer. On some of the plantations where moisture was under control in shape of irrigation all that was considered necessary was to plant in good season, open a valve to water inlet, "turn on the sun" and a crop was secured without consideration of the future. Today this practice has changed and even virgin soil has a fair share applied of the elements most necessary to sustain a cane crop, thus keeping the soil up to a state of fertility from which under normal weather conditions, a regular crop can be expected without drawing from the soil for one crop, to the detriment of those succeeding.

This subject of Fertilization is one on which much has been written and your committees of the past, composed of both scientific and practical men, have dealt in detail on its various phases; nevertheless there still remains much to be done, with vast scope for energy and experiment along practical lines for both Chemist and Farmer before we can thoroughly understand the freaks of nature in its relation to plants and minerals. Under such varying conditions as our climate offers, one district wholly dependent on rainfall another on irrigation, temperature varying in the Southerly exposed, to that of the North, while the same may be said of upper and lower lands within a very small radius, and in no two districts are the soils identical in their make-up. Under such variations of soils, temperature and moisture it is impossible to lay down any hard or fast rule in Fertilizer application, so as to obtain that which all of us are after—Cane, and that in large quantities and as near being made up of sugar as possible.

The writer will briefly direct your attention in this paper to the following points which he considers of first importance: Material to be used, quantity, applied method, and time of application.

Nitrogen being the most necessary element in order to encourage a thrifty growth, while at the same time the most expensive, it naturally creates the questions: How can we most readily supply the want? Nature does so in many ways, but not fast enough to meet our artificial methods of Agriculture; so Chemistry is at hand with aid in shape of a Commercial Fertilizer. Barnyard manure is undoubtedly the foremost to meet our requirements, not alone in supplying Nitrogen but in forming the base of a substantial growth while at the same time adding much organic matter to the soil, which in successive cropping is much reduced by our wasteful methods of trash burning. This commodity, however, on most of the Island Plantations is made only in limited quantities, and cuts but a small figure to meet the necessities of large areas being yearly cultivated. In passing it might be noted that in most of our stables this manure can be greatly augmented by liberally lit-

tering all animals with dried cane trash, or mill bagasse, where available, thus retaining most of the high carrying Ammonia excrements. Where not practicable to have such manures applied to crops immediately on collection, they should be stored under a roof, and a preserver applied in the shape of some acid phosphate, this saving a volatile loss as well as in a great measure that of leaching. Here, we use such a preparation at ratio of one pound to each animal fed in stable; as a result the pile in shed always keeps sweet and at year's end is taken from shed to field with little loss of its Nitrogenous contents.

Next in importance to stable manure as a Nitrogen manufacturer comes the Legume family, and where over the winter months a fallow area lies, a green-soiler of this family is much to be recommended. Numerous varieties have been tried and some with more or less success, but our thoughts at all times return to the Italian Lupin, as never failing. This plant on elevations from four to sixteen hundred feet has always been a success, or if a failure did occur it was from old or poor seed and from no objection to either climate or soil, while it has but few, if any, insect enemies which have usually caused the failure of other Leguminous plants we have tried. To secure best results the land is first plowed and harrowed across furrows, seed scattered broadcast 80 lbs. to acre, twice harrowed over and rolled with light horse roller, this ensuring the proper covering of seed or pressing them in so as to get enough moisture for germinating. Sown in October or November, the following March or April a dense growth from 2 to 4 feet in height just showing the pod forming, is ready for plowing in; at this stage it should not be overlooked that to let the bean develop is disastrous, as all the Nitrogen caught and stored up in the root nodules is very quickly used up by the plant if allowed to fruit, and proves itself to be as fond of Nitrogen as is a cane crop. A month after this growth has been covered in, the soil will be in the best of condition for planting with little left to indicate that a rank growth covered the land only a few weeks previous.

Filter residue and waste molasses are both deserving of notice as valuable in their fertilizing qualities, but may probably be considered under the heading of "By Products," and do not cut such a figure in our eyes as does the dollars and cents yearly looming up against us in shape of bills for Commercial Fertilizer.

Generally speaking, there are no two Planters who use just the same formula in the same quantities or at the same time, and each is anxious to know if better can be done by using something different, and get same or better results at less cost. No well established data is forthcoming to show that A gets

more tons of sugar to an acre by using less Nitrogen and more Potash, or vice versa, or just where the margin of application stops to be a paying proposition. Conditions vary so much that it seems hard to decide. A may give a fertilizer containing 12% Nitrogen and 18% Potash, and that in large quantities, while for B to do the same would be disastrous.

On the Island of Hawaii less nitrates are used than on the other Islands, probably on account of its more shallow soil and liability to get washed out by heavy rains coming unexpectedly at any time. Of your Committee Mr. Watt writes: "I find the fertilizer with a bone meal base works far better in this district than that prepared from a Guano base." Following are analyses of fertilizer used for the lower lands of Olaa:—

5—6% Potash from Sulphate.
8—10 Phos. Acid (Bone-meal base)
6— 7 Ammonia 2% from Sulph. Ammonia (Remainder from Organic).

On the uplands of Olaa the following formula is used:—

13—15% Phos. Acid from bone meal;
5% Ammonia as Sulphate, 2% from Organic;
7½% Potash as Sulphate, 3% as Muriate.

The above fertilizers being applied in an application of 500 lbs. per acre when the cane is one foot in height, with a second application of 500 lbs. "when the cane is closing in the rows."

Mr. Wells of Maui writes: "We have been using 800 lbs. of high grade fertilizer, making one application; this season we intend to increase to 900 lbs. making two applications of 450 lbs. each. First application in September and the second in November. Analyses as follows— :

Phos. Acid soluble and available	8%
Potash actual (½ from Sulph Potash).....	10%
Ammonia (½ from Nitrates)	8%

"During the months of April and May we give all our cane 300 lbs. of Nitrate in one application."

Here, we have in late years been applying the following formula:—

Nitrogen from Sulph. of Ammonia	6%
Potash from Suph. of Potash	12%
Phos. Acid from Guano base	6%

As a rule, giving two applications, first when the cane is well started in the furrows, 600 lbs., and again when the cane has closed in, 400 lbs. I do not feel satisfied that this fertilizer has been giving us the best results on all of our lands, and a year ago after analyses of soil from some of our lands, was informed that unless a good quantity of lime was applied much of the high-grade material applied was simply wasted. To counteract this condition of soil we limed a large area, applying 1200 lbs. of caustic lime per acre. At this date I feel satisfied

that the application of lime has been two fold in its benefits, first by its mechanical action on the soil and again in destroying much of the Fungoid spores and root disease germs lying in the soil awaiting new victims in the young cane shoots.

A good deal of discussion has arisen on the time of applying the various fertilizers; here again the varying canditions make a given rule impossible. Your committee member, Mr. Watt, writes: "I have tried fertilizer in the seed-bed, but find it to work best when applied after the cane has reached a height of one foot."

Here, in years past we have done both ways, although I feel assured it is a mistake to apply a readily soluble fertilizer in seed-bed, for the following reasons: That several weeks must elapse before the parent seed has developed sufficient root growth to assimilate any stimulant applied; at the same time, the longer this material lies in the soil and not utilized by plant the greater its chances of leaching away. While again it is reasonable to suppose that when cane has attained a height of one foot or more the parent has developed immense root growth, and from the increased growth of its offspring requires nourishment to a greater extent than when it simply fed it through the medium of its own juices.

Regarding the time of second application there seems to be no diversity of opinion, simply "When the cane commences to close in." That being the time when the young shoot has started off to fight its own battles, forming joints at its base, developing lateral shoots, and striving to gain a foothold with its tender rootlets amongst the network of roots already established by its parent and near neighbors. No more opportune time could be selected to apply the food required, to stimulate and assist in the keeping up of its strength and vigor.

In applying the bulk of commercial fertilizers on irrigated plantations there is a greater security from loss through leaching than on plantations where the unexpected happens, and a heavy rain may come at any time, and it matters not what the mode of application may be, the chances present themselves; it seems therefore that frequent applications if of less amounts are better than one large quantity being applied.

In the distribution of fertilizer, no matter whether by hand or machine, the main objects are: even distribution and at cheapest rate. Different methods are pursued under diverse conditions, so that it is unnecessary here to follow its disposal at further length.

Mr. Stodart of your Committee, whose time has been very

fully occupied, in order to assist this Committee asked Mr. Donald, Chemist, Eleele, to give his views, which I herewith include for your consideration.

Respectfully submitted,

DAVID FORBES,
Chairman, Committee on Fertilization.

Kukuihaele, Hawaii, Nov. 1st, 1906.

Eleele, Kauai, Oct. 1st, 1906.

FERTILIZING.

The yield of sugar per acre in the Hawaiian Islands has increased 50 per cent. in the last ten years. This is due to a great many causes, the principal of which are deep plowing, fertilizing, irrigating, and improved methods of cultivation and manufacture. Of these, none can be estimated even approximately, with the possible exception of the last. How much of the increase is attributable to fertilizing must be left to conjecture, and, as the other contributing causes are certainly responsible for a large proportion, it is more than probable that fertilizing receives much more than its due share of the credit. Mr. Eckart has repeatedly pointed out that it is far from easy to make reliable and unequivocal deductions from tests, even with the prearranged conditions at an experiment station. The desultory experimenting which has been conducted on plantations is of little value even to the experimenters, hasty deductions being made from very incomplete data. Only the results obtained by skilled and fully equipped experimenters can have complete confidence, and we propose here to use some of the data of the Hawaiian Planters' Experiment Station to show that the skepticism with which many regard the very liberal use of fertilizers obtaining in Hawaii has a not unsubstantial foundation.

The use of "high-grade" soluble fertilizers has gradually increased in these Islands until there is now little else used. But the argument advanced against the "low-grade" fertilizers that their plant food constituents are very slowly available for the plant is rather one in their favor. The fundamental idea in applying fertilizers is to restore to the soil the constituents removed by the plant and, fortunately for us, those constituents are all present in very slowly soluble form. The requirements of the plant are small and it has never been shown that the application of phosphoric acid, potash or lime has any material influence in increasing the yield of cane, provided the soil is not deficient in those constituents. Referring to Mr. Eckart's

valuable report published in the Planters' Monthly in 1904, we see that either phosphoric acid or potash alone, applied to the soils at the Experiment Station, actually reduced the yield of cane in the last crop, with both Lahaina and Rose Bamboo. (H. P. M. 1904, p. 109.) The result is strikingly confirmed by the second series of tests (H. P. M. 1904, p. 147), in which the highest yields of cane are obtained where potash or phosphoric acid is omitted. These results are almost identical with those published about a year ago in the report of the Leeward Islands Experiment Station and also with those published about the same time in the report of the British Guiana Botanical Gardens. We may therefore conclude (unless experimental evidence to the contrary is forthcoming) that while potash and phosphoric acid may be supplied in small quantities to compensate for what is lost in cropping, an excess is not only useless but positively harmful. This statement probably applies to lime too, although the available data on this point are few. Where the mill ashes, mudcake, and molasses are returned to the soil those fertilizers could be cut out of the plantation expenses altogether. (In regard to lime, however, it should be remembered that this material, apart from its function as a plant nutrient, is of value in the amelioration of sour soils and in reducing the harmful effect of salt and certain other poisonous compounds in the irrigation water and the soil.) Professor J. B. Harrison, as the result of twenty-four years' experimental work, concludes that cultural operations make available from the soil more potash and lime than the cane utilises; while J. T. Crawley, in a paper recently read before the Honolulu Engineering Association, calculates that a dark red soil to a depth of one foot contains enough lime for 100 crops, phosphoric acid for 47 crops, and potash for 18 crops and this is assuming all those materials to be removed from the soil and never returned.

When analysis shows that a soil is poor in the above named elements their application in a highly soluble form is wasteful, for, as already stated, the cane can only assimilate a portion beneficially while a large part is removed by drainage. If there is abundance of organic matter (humus) and moisture in the soil, there is no substance insoluble, and with *very finely divided* "insoluble" fertilisers the cane takes what it requires and leaves the remainder for a future crop. Referring to the Eckart report again, the only direct comparison we are given of soluble and insoluble phosphates is very favorable to the insoluble form (H. P. M. 1904, p. 151) even for a single crop; it would be instructive to have that experiment extended over many crops and the results expressed in monetary terms.

When we consider the other essential cane food—nitrogen—we again find all reliable experiments in agreement. This is

the element beyond all question the prime influencing factor in the nutrition of plants. It is also, unfortunately, the most expensive, and a large proportion of that taken up by the crop is removed permanently from the soil. Its application in increased quantities is accompanied by increased yields up to a limit which cannot be definitely set, and which varies greatly with variations in the other conditions. Harrison of Guiana has attempted to predict the increased yield of cane for each increment of nitrogen up to a definite limit, but his conclusions are only of local value. The question as to which combination of nitrogen is most remunerative is undecided, but here again it should be considered that the nitrogen of very soluble fertilisers such as nitrate of soda and ammonium sulphate is only partly used, while practically all the nitrogen of slowly soluble manures such as ground bone, stable manure, mudcake, dried blood, &c., is used up by the plant. There are no recent experiments which enable us to compare accurately the net financial returns from a number of successive crops grown with natural and artificial manures, but theory and practice both indicate that the benefit is greater (because more lasting) when the natural organic manures are used.

To sum up: Recent experiment tends to show that a large proportion of the money now expended on the so-called "high grade" soluble fertilisers could be more profitably devoted to fertilising with slow-acting nitrogenous manures and to the other cultural operations of a plantation.

Respectfully submitted,

JAS. W. DONALD.

Mr. Eckart replied briefly to the statements made in the subreport of the committee, of the increased value of insoluble fertilizers over the soluble, and that the cane requires a small amount of plant food. Mr. Eckart said that careful analysis of many varieties of cane have shown that very large amounts of phosphoric acid, potash and nitrogen are taken up from the soil; that in actual practice it is not attempted to put back into the soil all that is taken out by the cane and drainage, and stated as an instance that Lahaina cane takes up about 89 pounds of potash per ton of sugar and that the mixed fertilizers in use put back into the soil much less potash than the cane takes up. Therefore, if the materials necessary for the use of the plant were returned to the soil in an unsoluble state it would be a long time before the plant could avail itself of the ingredients in the fertilizer which it needs. Mr. Eckart thoroughly approved of green manuring the fields to supply nitrogen and replace organic matter in the soil.

The report of the Committee on Forestry, in the absence of the chairman of the Committee, was presented by the secretary, and is as follows:

REPORT OF COMMITTEE ON FORESTRY.

To the Hawaiian Sugar Planters' Association:

Gentlemen: The year 1906 has not produced any radical change in the status of forestry in this Territory.

FOREST RESERVES.

Progress in the establishment of official forest reserves has been marked by the setting apart of five additional areas, as follows:

1. Island of Kauai, District of Puna, Kealia, being the mountain section back of the land occupied by the Makee Sugar Company, 9,935 acres, of which 7,385 acres are government land not under lease, and proclaimed as a reservation.

2. Island of Oahu, District of Ewa, being the mountain section lying back of the Honolulu and Oahu Plantations, and extending to the ridge of the Koolau range of mountains, 28,550 acres, of which 4,759 acres are government land, now available and placed under the reserve law.

3. Island of Hawaii, District of Kau, being the land lying back of the Kapapala Ranch, the Hawaiian Agricultural and Hutchinson Plantation Company's plantations, 65,850 acres, of which 35,988 acres are government land actually reserved.

4. Island of Hawaii, District of North Kona, at Honuaula, 665 acres, all government, and definitely reserved. It consists of a heavy growth of Koa.

5. Island of Oahu, District of Waianae, at Waianae-kai, 3,257 acres, of which 3,150 acres are government and reserved. This land forms the water-shed of the western and northern slopes of the Waianae Valley. It belongs to the government, and was under lease to the Waianae Plantation Co., which cancelled its lease in order that the reserve might be created.

RESERVES ON PRIVATE LANDS.

During the year an understanding has finally been arrived at between the government and the owners and lessees of approximately 27,800 acres of land lying within the boundaries of the Hamakualoa and Koolau Forest Reserve, on the Island of Maui, by which the said area of land is surrendered to the government as a part of the Forest Reserve, for a term of years. The agreement provides for maintenance, protection and increasing of the forest, while at the same time permitting the owners to make economic use thereof, subject to the rules and supervision of the Board of Forestry. The agreement has not yet been signed by all the parties. As soon as it is, it will be published in full.

Other owners of forest land are respectfully urged by your committee to consider the advisability of similarly coöperating

with the Forestry Board, both for the purpose of getting the forests of the Territory under systematic and intelligent control and management, and for the purpose of creating an interest in, and moral support for the protection and development of forests.

REFORESTING.

The Territorial government has now set apart ten forest reserves, aggregating 318,579 acres. Most of this area is covered with forest, but in many portions the trees are scattering, or sickly, or have disappeared altogether.

The energies of the Board of Forestry have thus far been chiefly directed toward getting reserves located and set apart.

Much still remains to be done; but the time has come when protection to the reserves must be given, and reforesting on a considerable scale be begun, or the good beginning already made will come to stand-still. This Association can accomplish much in this connection, in two ways:

First, by passing a formal resolution, petitioning the legislature to make an appropriation for forest rangers and reforesting. This will give the proposition the moral support of the organization representing the majority of the wealth of the Territory.

Second, by individual members of the Association asking the support by their senators and representatives, of appropriations for the aforesaid purposes.

Third, by individual members of this Association themselves engaging in tree planting.

PRIVATE REFORESTING.

Your committee is glad to say that the cause of reforesting has made steady progress during the year, among private individuals.

The Hawaiian Commercial, the Maui Agricultural and the Haleakala Ranch Company, on Maui; the Parker Ranch on Hawaii; the American Sugar Company on Molokai, and the Maunawili Ranch on this island, have continued their previous systematic planting record.

On Oahu the Oahu Railway & Land Company and the Waianae Sugar Company have accepted the offer of the Board of Forestry to furnish free expert advice and supervision in the establishment of forest nurseries, and the same are now under way.

The Honolulu, Oahu, Ewa and Waialua plantations have also intimated their desire and intention to, at an early date, inaugurate systematic planting plans, in coöperation with the government.

Your committee urge the soundness of every sugar plantation devoting some attention to tree planting, each year, if for no other purpose than for supplying fire-wood to their employees, an item of considerable expense even in the best wooded districts, and of

large expense where fuel is so scarce that coal at eight to ten dollars a ton is now used for domestic fuel.

The Board of Forestry is making a standing offer to supply to all comers:

(1) Fresh tree seeds, collected by its employees, in Hawaii, at cost of collection;

(2) Free advice of experts as to kinds of trees best adapted to individual localities;

(3) Free personal advice, supervision and instruction as to methods of establishing tree nurseries, transplanting and care of trees.

(4) Free advice as to methods and rules governing lumbering existing forests, so as to secure the greatest profit, at the minimum of destruction of the remaining forest and maximum of growth of new forest.

A number of sugar plantation managers have availed themselves of the above offers during the past year, as the outcome of which planting programs are now under consideration, which it is to be hoped will early materialize into activity.

Your committee present the following resolution, which they suggest be adopted by this Association, with a view to a continuance and development of the forest work which has been begun by the establishment of forest reserves, viz.:

"Resolved, That the Hawaiian Sugar Planters' Association hereby expresses its hearty approval of the policy of setting apart forest reserves, inaugurated and now being prosecuted by the Territorial authorities;

"That it is the opinion of this Association that said policy should be supplemented:

"(1) By providing rangers to guard and protect such reserves from fire, trespassers and depredation;

"(2) By the initiation of systematic reforesting of such portions of said reserves as are not now covered with trees;

"That we hereby petition the legislature of the Territory to make adequate appropriations for the purposes aforesaid."

Respectfully submitted,

LORRIN A. THURSTON,
Chairman, Committee on Forestry.

Following the report of the committee, Mr. R. S. Hosmer, Superintendent of Forestry, presented the following additional report:

REPORT OF SUPERINTENDENT OF FORESTRY.

To the Members of the
Hawaiian Sugar Planters' Association,
Honolulu.

Gentlemen: In its report to the Association the Committee on Forestry has outlined the work done during the past year by the Territorial Forest Service and has made certain recommendations to which I trust the Association as a whole will give earnest attention.

In coming before you this morning I wish to emphasize the importance of the committee's recommendations and to bring to your attention one or two points not considered in its report.

For the past two and a half years the main energies of the Territorial Division of Forestry have been devoted to the creation of a forest reserve system. Today the table of existing forest reserves shows ten tracts, aggregating an area of 318,579 acres, that have been officially declared forest reserves under the law by proclamations by the Governor of the Territory.

But as was pointed out in my last annual report the table of existing forest reserves at any one time is but a poor index of the work actually done up to that date. For no account is there made of other reserve projects in various stages of completion. Following a public hearing to be held on Nov. 28th, 1906, it is practically certain that two additional forest reserves will next week be added to the list; one in the Hana District, Maui, (14,825 acres), the other on the land of Lualualei, in the District of Waianae, on Oahu, (3,743 acres). And before the end of the calendar year I confidently expect that three other good sized areas in different parts of the Territory will fall into line as established forest reserves.

Of the area within the reserves already officially declared (318,579 acres) 108,704 acres is government land that has been actually set apart. Of the remainder something over half is government land under lease for varying terms. As the present leases expire this area will gradually come into the class of land actually set apart. The rest of the area within the forest reserve boundaries is forest land owned in fee simple by the plantations and large estates.

To adequately protect and efficiently administer the forest reserves a force of forest rangers is needed. Provision was made for such an organization when the present Board of Agriculture and Forestry was created, but at the time of financial retrenchment, two years ago, the item providing for this work was cut out

of the appropriation. With the existing reserves and those about to be added to the list the need for an administrative service is most urgent.

The presence of a forest ranger, clothed with police power as far as the reserves are concerned, would do much toward suppressing various forms of trespass by irresponsible persons and would especially help toward preventing forest fires, which can now for the most part be traced to carelessness or negligence on the part of persons living in the neighborhood of the reserves. Other duties of a forest ranger would be to see that the reserve boundaries were respected, to make minor repairs in the boundary fences, to keep existing trails in repair and to extend the trail system to facilitate the rapid movement of fire fighting gangs should the need for such action arise.

To the end that an appropriation for a ranger service may be obtained from the coming Legislature, I respectfully but earnestly urge that the Association follow the recommendations made by the Committee on Forestry and pass the resolution suggested in regard to this matter.

Another point which I wish to emphasize is the importance of a closer coöperation between the private owner and the Division of Forestry in the management of the privately owned land within the established forest reserves.

To secure the best results in the management of any given forest reserve there should be put into operation an organic plan embracing all the several units of which it is made up. With the establishment of a forest ranger service and with the greater share of attention which it is expected the technically trained staff of the Division of Forestry can give to this phase of forest work in the future, coöperation on the part of the private owner can but be of benefit to him, while by so doing he will increase the moral support of the forest movement and thereby help the Division of Forestry to sooner accomplish the very practical object for which it stands.

The agreement entered into between Messrs. Alexander & Baldwin and the Government regarding the surrender of the lands in the Koolau Forest Reserve on Maui is now in hand, and may be advantageously consulted in this connection. I shall be glad to take up this matter at any time with any one interested and go into details as to the ways and means by which any given reserve may be put to its best use.

The one other point on which I would touch is that of forest planting, especially forest planting by the private owner. Each year sees the problem of obtaining construction timber and wood for the various plantation uses grow more and more serious, while on many of the plantations the question of fuel supply is also one not to be neglected. On almost every sugar plantation are areas of waste land on which it is not possible or advisable to grow cane, but which could be made to produce forest trees.

Through forest planting, by a careful selection of species, many of the future needs of the plantation can be provided for, for although we cannot expect to compete with the timber trees of the Pacific Northwest, there are many purposes for which our island grown woods can be used, such for example as bridge timbers, piles, fencing and railroad ties.

During the past year a number of the plantations have taken advantage of the standing offer of the Division of Forestry to assist private owners by advice and suggestion as to the best method of conducting their forest work. During the coming year I hope we may have many more such calls. The good example already set by several of the plantations in the way of forest planting should be followed by others.

In closing I wish once more to emphasize the fact that all of the work of the Division of Forestry is distinctly practical in its aim and object.

The forest reserves are made primarily that the forest cover on the water sheds, by being protected, may assist in conserving the streams, so that the water from them may be used for power, irrigation or fluming. The forest plantations are established with the idea of even more direct economic return. Both rest on the idea that the forest is best perpetuated through wise use.

It is not necessary to argue the benefits of forestry before this Association. Your past record shows that clearly. But to do the many things that await attention the Territorial Division of Forestry requires the continued support of all its influential friends.

At no time has there been more need of forestry in the Territory of Hawaii than at present. The opportunities for useful work are great, but without money they can not be grasped.

Your Committee on Forestry has pointed out what the Association may do to help meet the present need. Will you not give the measures so recommended your cordial support?

RALPH S. HOSMER,
Superintendent of Forestry.

Honolulu, T. H., Nov. 20th, 1906.

In reply to questions, Mr. Hosmer stated that the policy of the Forestry Board in dealing with lands turned over to the Government by private parties for forestry purposes, is to permit the owners of the land to make economic use of the forest under reasonable rules and regulations for the protection and development thereof; that rubber, hemp or other economic crops could be planted and the plantations or others owning the land could enjoy the profits therefrom; that it is intended that the use, maintenance and development of the forest reserves shall be in such manner as will not materially interfere with the conservation of the water supply on the lands; that the Forestry Board desires to

later establish a ranger system and employ men trained in forestry in order to be able to give careful attention to the management of the forest reserves, and to so coöperate with the private owner that he will obtain the greatest advantage possible.

Mr. Hosmer further expressed his approval of lumbering operations in certain districts where the work could be carried on under careful supervision. That the koa tree is practically the only tree growing here of commercial importance—koa lumber commanding a sufficient price to enable it to be cut out at a profit; the economic use of forests in the Islands applies, however, almost solely to the dry sides of the Islands, and that where the object of establishing the reserve is only to conserve the moisture a heavy and thick growth should be encouraged, and no trees cut.

Mr. J. T. Moir, chairman of the Committee on Labor Saving Devices, thereupon submitted the following report of his committee:

REPORT OF COMMITTEE ON LABOR-SAVING DEVICES.

Papaikou, Hawaii, October 29th, A. D. 1906.

To the Members of the Hawaiian Sugar Planters' Association:

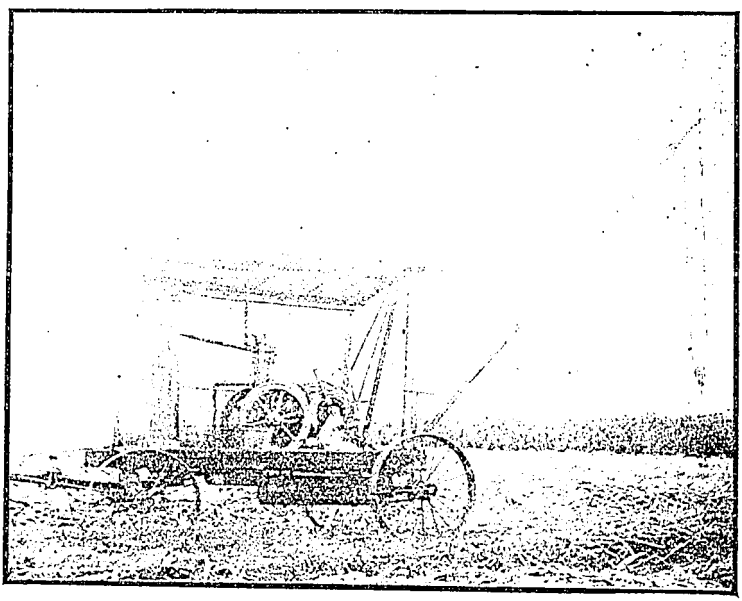
Gentlemen: As chairman of the Committee on Labor Saving Devices, composed of Messrs. J. A. Low, H. H. Renton, F. Meyer, H. A. Baldwin and the writer I offer the following:

I present herewith and make part of this report a communication from J. M. Horner, Kukaiau, which is well worthy of consideration and much attention; a communication from J. N. S. Williams on "Costs of Cane Loading," a communication from J. Watt, Olaa, with sketch of sugar bag holder and description thereof, also a testimonial to the great improvement made in handling cane with the "Kennedy" Cane Loader over old methods, all of which speak for themselves; also a statement from Waiakea Mill Co. regarding cost of "Loading and Transportation of Cane."

COMMUNICATION FROM J. M. HORNER.

"Evidently the object here aimed at is to show planters how to produce more cane with our present labor or the same amount of cane with less labor by using better machines or using our present ones with greater skill, etc.: either are objects worth striving for, and to thus strive is a duty we owe to ourselves, our neighbors and our country at this time, seeing our laborers are decreasing in numbers and higher wages demanded. That more labor can be done with our present labor force by painstaking and a more skillful use of the horse and labor saving devices goes without saying. Many of our plantations have improved in their use of the horse and labor saving devices, while others are just

where they were twenty years ago, using the old mould-board breaking plow, oxen instead of horses or mules, hoes instead of cultivators, and some are still using contract labor to pack cane out of the field up upon cars when they could use horses, where one animal could do the labor of four men, thus not only doing it with less men but also at much less expense. Just now the howl goes out for more help and less wages for plantation labor. Let us see. 'Extra help' does not always mean more men. More horses in some cases, where one horse will do the work of four men; a more wise superintendence of present help; we have seen men at work that could have doubled their output had they been put to work differently or with a different tool. We want a more

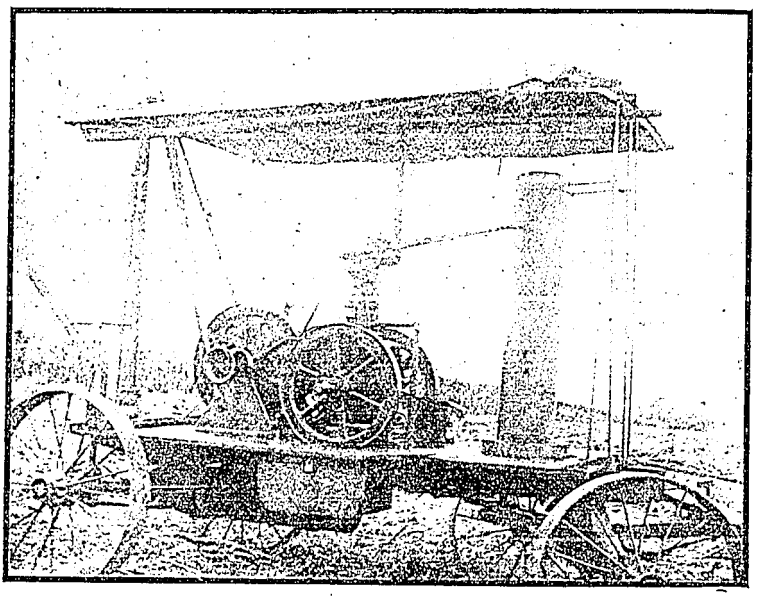


SCOTT'S CANE LOADER.

persistent use of labor saving devices. *We must study how to get the best results from our help, whether they be men, animals or labor saving devices. It is the inventive ingenuity and the skilled use of labor saving machinery, not numbers of men, that has placed the United States, in wealth, head and shoulders above any other nation.*

The late British statistician, Mulhall, in the North American Review, writing upon this matter, begins by saying, 'If we take a survey of mankind in ancient or modern times as regards the physical, mechanical and intellectual force of nations, we find nothing to compare with the United States in this present year of 1895." As Mr. Mulhall puts it, "An ordinary farm hand in the United States raises as much grain as three in England, four in

France, five in Germany or six in Austria, which shows what an enormous waste of labor occurs in Europe because farmers are not possessed of the same mechanical appliances as in the United States." These advantages have come to the American people not from superior physical strength, but from their inventive ingenuity, their skilful use of labor saving devices and a large country to use them in. History informs us "The American farmers, during the Civil war, were deprived of much of their help by the government taking them for soldiers, teamsters, etc." Hundreds of thousands were taken at a time when they were much required upon the farm, produce was high and rapidly rising; wages of farm laborers were also advancing, but the farmers did not des-



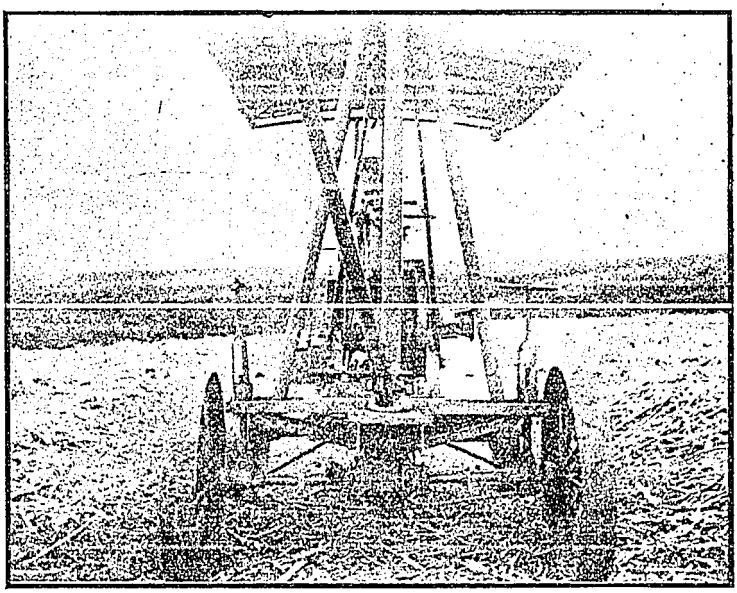
SCOTT'S CANE LOADER.

pair. Necessity was the mother of invention to them and as by magic sprang into existence improved gang plows, seed sowers, mowers, reapers, corn planters, wheeled cultivators, hay tedders, wheeled horse rakes and many other labor saving devices, and by their use measurably supplied the laborers taken for the war. Not only was the labor of man much multiplied by these machines but they were so well adapted to the work and the circumstances of the times that old men, boys and in some cases women mounted the spring seats and guided the team and machine while doing the work—sisters raising the food required by their brothers in the army.

Machines were so great a help that notwithstanding so large a number were taken from the producing class and became con-

sumers and destroyers, the North increased in material wealth during the war of rebellion. Even so we must not despair though our help be scarce and unskilled and wages high and rising, but strive to multiply help by the more persistent use of the horse and labor saving machinery as skilfully as did the Americans, and thus work out our destiny by brain as well as brawn. It would be more creditable to increase the efficiency of our available help to do our work than to hire thousands of more men to do it. More men will require more money.

We will now refer to some of our labor saving devices which some of our planters have not yet used. We have now numerous sizes of the common mould-board plow, double and single, and



SCOTT'S CANE LOADER.

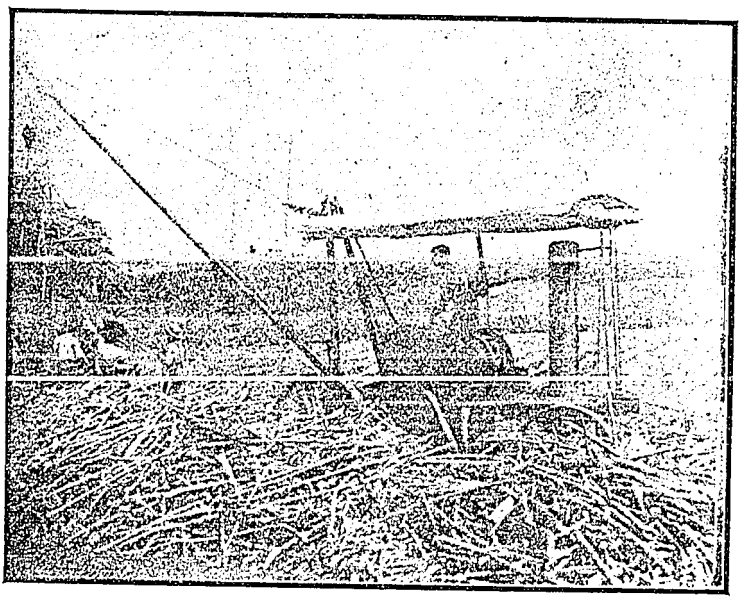
different sizes and kinds of the double and single disc plows for different kinds of work; also different kinds of cultivators—some of recent origin—for destroying weeds and putting the soil in good tillage condition.

All planters admit the wisdom of a thorough preparation of the soil before planting. With us twice plowing with the reversable side hill disc plow is a sufficient preparation for the furrow plow to follow; it equals in soil preparation, twice plowing and twice harrowing when plowing is done by the mould-board breaking plow. What we wish to impress upon those interested, is that *one man* with *three horses* will do better plowing and more of it daily, working with the disc plow on these hilly island lands than can be done by *two men* and *five horses* working with the mould-board breaking plow. Here it may be seen,

nearly one-half the expense of preparing the soil for planting would be saved, if the disc should be used instead of the mould-board breaking plow.

As a suggestion we say the last plowing should be done only a short time before planting, so as to have no weeds growing while planting is being done. When finished the field having no visible weeds may be looked upon with thankfulness.

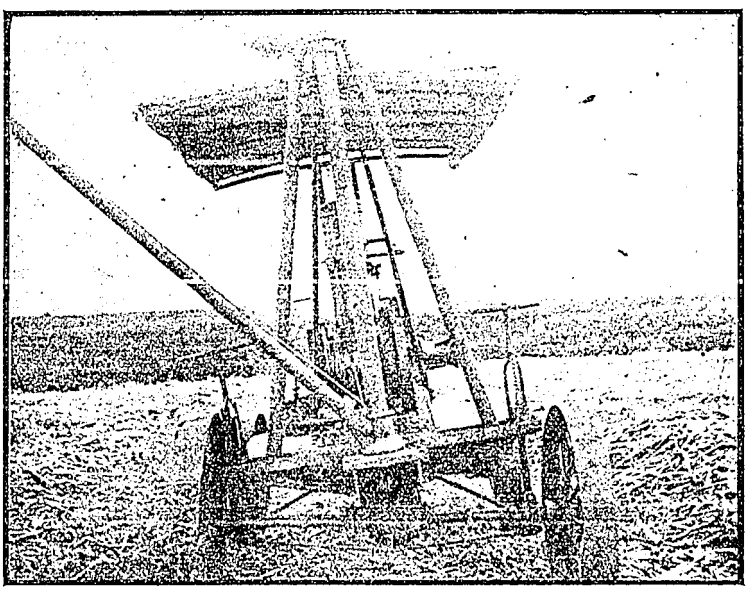
Now comes the after-care and cultivation of the young cane and ratoons where it is thought more mistakes are made and labor lost than in any other department of the plantation.



SCOTT'S CANE LOADER.

Weeds as well as cane are now struggling for life, growth and seed, and superintendents being hired to grow cane, not weeds, will truly have a battle to fight to prevent the weeds from consuming the food, moisture and sun life which he intended for the cane only; this battle cannot be commenced too soon after the weeds appear. It will be comparative light work to conquer the weeds if commenced at the right time and use the best known machines for the purpose. The wise superintendent will direct when to do, how to do, what to do and what to do it with. It is believed better and cheaper crops can be grown with less man help than is now used on some of our plantations, if a different course of cultivation was more thoroughly and persistently pursued. We believe the hoe is used too much and the cultivator too little. On some plantations it is hoe, hoe, hoe; we say cultivate, cultivate, weeds or no weeds, ditches or no ditches, cultivate and only use the hoe where the cultivator cannot reach. If hoeing was as cheap as

cultivating, the cultivator should still be used from the fact that cultivation loosens up the soil as well as kills the weeds, a thing quite essential to assist the growing cane. The finely pulverized soil serves as a mulch which prevents a too rapid evaporation of moisture, hence a better crop of cane can be grown where the cultivator is liberally and wisely used than if the land is only scraped over with the hoe, and we think the superintendent who does the work of one man with the hoe, when he could do the work of eight men with a horse and cultivator is not doing the right thing for the country, his employer or himself. We now have better cultivators than we had years past and better adapted for use in both dry and wet districts. Never let weeds get strongly rooted or produce seed among young cane. Go for them



SCOTT'S CANE LOADER.

as soon as they appear with the side harrow and again when the cane is all up; after this a few small weeds in the cane may require the hoe. The wise use of the cultivator and once hoeing the first two or three months after planting will keep the land as free from weed—in all wet districts—as at planting time at an expense of $2.50 per acre. After this, weeds or no weeds, the best cultivator should be wisely used over all the new plant every ten or fifteen days in all wet districts until the cane is laid by. In irrigating districts all should cultivate to keep the soil in good tilth to prevent evaporation. *Cultivation is covering the cistern to retain the water for the use of the cane as well as to destroy weeds.* Large weeds among the plant cane—though dead—are a discredit, and thrifty growing ones a disgrace to the plantation.

Killing weeds when young is a "stitch in time." All farmers should study labor saving devices for their own good. Machines skilfully used not only double or quadruple man's labor but as a rule make man's labor easier and more valuable, as he is required to render a service with both brain and brawn when using machinery.

The difference in labor alone between cultivating and hoeing is very marked; five men to one acre or one man and one horse to four acres is such a difference that no planter is justified in slighting, and then, as we claim, cane is much more benefited by a liberal cultivation, than by simply killing weeds with the hoe.

Let us put our brains to work and *try to do better* and lift ourselves from the disgrace we are now suffering under by being compelled to pass over our plantations to be bossed by laborers and no longer confess by our own acts that they know better how to do our work than we do. Some plantations have advanced to the point of dismissing their lunas.

Should this be generally accepted superintendents and bookkeepers as well as white lunas would all be out. It is to be hoped this may never occur, but as so large a part of it is now being done, it all may be if the right course is not taken to prevent it.

We affirm that so long as labor saving devices are neglected, so long will the laborers hold their grip on the plantations. We cannot blame them. Every plantation machine is intended to do the work of two or more extra men; the horse wisely used will do the labor of two or more extra men. Allow me here to refer to one fact. Twenty years ago cane was carried from the field by men and placed on cars at an expense of twenty cents per ton, if distance to pack the cane was not too great. From reports this packing and loading cane is yet being done on many plantations at about the same or greater expense, thus requiring 34 men to load 170 tons of cane per day and requiring railroads to be placed through the fields not more than 300 feet apart. One more fact: In 1882 and 1883 this amount of work was done on one plantation with 12 men, 9 horses, 4 sleds and a few devices at an expense of 11 cents per ton of cane loaded, which included the labor of man and beast, depreciation in value of devices used, interest on the investment and only required rails to be laid every 700 feet apart. Thus it may be seen by adopting these labor saving devices, every plantation now loading cane upon contract for 20 cents per ton will save daily $18.30 and do it with 22 less men. With 5 such rigs working they would save daily $91.50 and do the work with 110 less men. The cost of this rig is, 9 good horses with harness, $150 each=$1350. Sleds and double trees, $12 each=$48. Ropes, blocks and tripod, $50. Whole investment, $1448.

(Sgd.) J. M. HORNER.

COMMUNICATION FROM J. N. S. WILLIAMS.

Responding to your request I enclose you herewith a statement of what the Wilson-Webster Cane Loading machines have done on this plantation during the season now over. While the results are not as good as we expect in the future, we feel encouraged to continue using the machines, being satisfied that much better results will be obtained with more experience.

I have to say that in my opinion the machine as at present constructed attempts too much for one man on the machine, the result being that while the man is hoisting cane into cars, the bundles are not being dragged to the machine, and vice versa, time is thus wasted.

I believe that two machines to work in conjunction would overcome this defect. We are now planning to make a car having machinery on it for pulling up the bundles alongside the portable tracks; this car will go on the same tracks ahead of the hoister, and if required can come back through the frame of the hoisting machine; the bundling gang keeps with this car; the hoister then follows up, lifting the bundles into the cane cars. By this means with one extra man and an extra supply of slings, I feel sure that the output of the machine could be doubled, and the expense of running reduced, as there would be fewer breakdowns, owing to the simplification of the machinery; the work also would be well within the capacity of the man available to run this class of machinery.

As it is now, the attention of the man running the hoisting arrangement is constantly distracted by yells of "Haul in" from the bundlers, who are naturally anxious to get as much cane as possible to their credit, and if in a misguided moment he neglects to hoist into the car in order to accommodate some strenuous friend in the bundling gang, he gets into trouble with the overseer and becomes "rattled," with the result of a general tangle and stoppage of the work.

(Sgd.) J. N. S. WILLIAMS.

Puunene, Maui.

RESULTS FROM THE WILSON-WEBSTER CANE LOADING MACHINE.

Ratoon cane, stony field, steep grades. Yield of cane 50 tons per acre. Two machines delivered during month 1318 cars of 3½ tons each ..... 4613 tons

Labor:—Contract	532 days men	
	230 days women	
	92 days boys	
@ 14c. per ton cane.		$645.82
Day work, 43 days @ $28		46.20
Mechanic 1 month....		80.00
		$772.02
Repairs and Supplies..		206.29
Total Cost		$978.31 or 21.2c. per ton

Plant cane, level ground, smooth. Yield of cane 75 tons per acre. Two machines delivered during month 2012 cars of 3½ tons each ..... 7042 tons

Labor:—Contract	741 days men	
	265 days women	
	25 days boys	
@ 14c. per ton cane.		$985.88
Day work, 66 days @ $28		71.20
Mechanic 1 month....		80.00
		$1137.08
Repairs and Supplies.		126.13
Total Cost		$1263.21 or 17.9c. per ton

COMMUNICATION FROM J. WATT.

I herewith enclose a sketch of a sugar bagging arrangement which we installed here a year ago and which has given good satisfaction. I requested our engineer to make out a sketch of the whole thing and I enclose his answer to me.

As the sketch and description explain themselves, I need not go into any details. I can only say that it has caused a great saving in the bagging of sugar and has in every way proved satisfactory.

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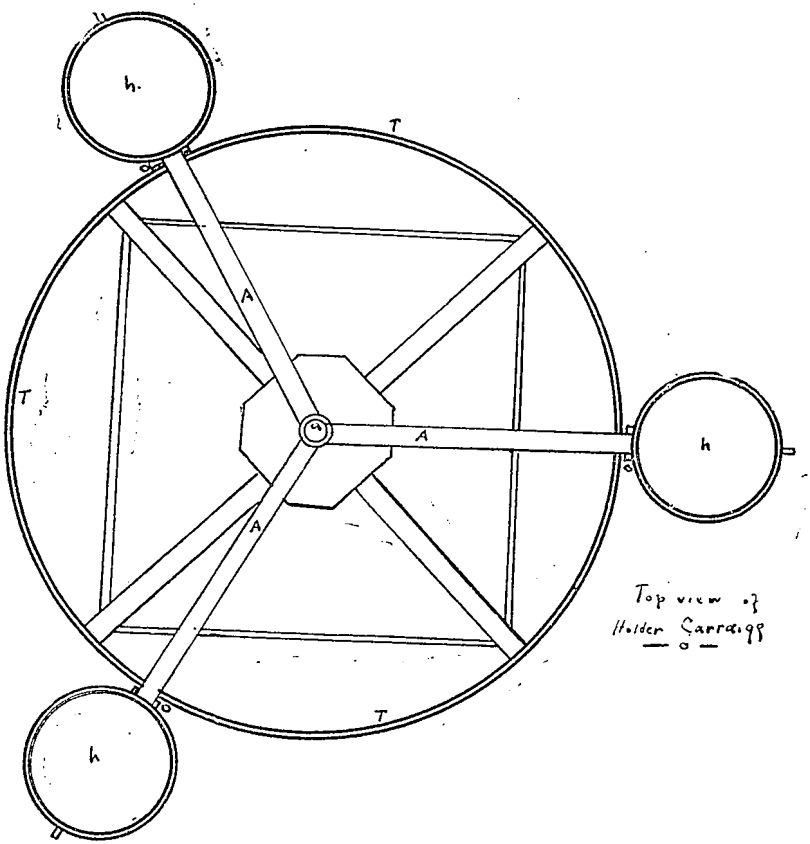
The only other labor saving device which we installed here last year was three of the Kennedy cane loaders, which we used to great advantage over former methods.

We worked two of them in Olaa while we had to railroad cane here, and one in Puna, and they in every way came up to our expectations.

(Sgd.) J. WATT.



STATEMENT OF COST OF LOADING AND TRANSPORTING CANE FROM WAIAKEA MILL CO.

Loading Sleds and Proportion Office General and Superintendent Expense	$10,347.98	or 11.88	cents per ton
Hauling Sleds to Machine...	8,627.04	9.91	" " "
Repairs, Oil, Gasoline and Labor at Machines.....	1,391.90	1.60	" " "

Labor on Locomotives and Cars, Oil and Coal.....	5,650.98	6.49	"	"	"
Fluming	79.84	.09	"	"	"
Interest on Value Railroad and Machines, 6% on $42,000..	2,520.00	2.90	"	"	"
	$28,617.74	32.87	"	"	"
Average cost per ton, 1903		36.76	"	"	"

AGRICULTURAL IMPLEMENTS.

BURSTING PLOW.

This tool has been at work here at Papaikou now for nearly three years; it was got up by our head overseer at that time (Mr. Webster) and our blacksmith (Wm. Forbes). If we had not devised such a tool, it would have been next to impossible to plow the stubble and be able to cultivate and plant owing to the tremendous large stools being thrown up by the plows formerly used.

It is composed of a curved beam with two large discs attached on each side of the beam which straddles the cane row, then the revolving coulter follows up and splits remaining or center piece, and sub-soiler follows coulter; attached to the bottom of the sub-soiler there is a three-cornered piece of steel (piece of an old coulter), which cuts under the center piece making a thorough burst up of the whole cane row. Mr. Scott, manager of the Hilo Sugar Co., has a plow somewhat similar to this, with four discs, which also makes a splendid job of bursting up the ratoon cane row.

DISC CULTIVATOR.

We have another tool, also got up by Mr. Webster, in the shape of a disc cultivator which can be used in hoeing away from the cane as well as throwing dirt to the cane. We have had same in operation here for over five years and find it a great labor saver.

HORNER CULTIVATOR.

This cultivator, which was got up by Mr. A. Horner, Kukaiau, is one of the greatest weed-killing tools the writer has ever seen. It gathers the weeds and buries them and has saved the plantations thousands of dollars, principally being used in the wet districts.

BENECIA-HORNER NO. 3 RATOON AND CANE DISC PLOW.

This is a most useful implement and if properly handled is

capable of many uses and can be the means of saving at least one-half of the hoeing generally given ratoons.

DEERE BEDDER.

This implement is used in plowing ratoons immediately after burning of trash and is of great assistance to the young shoots in starting up.

FERTILIZER DISTRIBUTOR.

Mr. Webster, Pepeekeo, has made and put in operation a fertilizer distributor which takes three rows at one operation drawn by two mules and will cover at least 20 acres a day at the rate of about 375 pounds per acre. I sub-join a communication from Mr. Webster with reference to this implement:

"I have to state that we have at work a three-row fertilizer distributor. While the construction could be improved upon by a little time and expense, our attempt demonstrates that the three-row machine is feasible. The draft on a pair of mules is light and the area covered is regulated by the traveling powers of the team, length of rows and quantity applied per acre.

"Applying 3 bags (375 lbs.) to the acre, we can put on from 60 to 70 bags a day according to length of rows, etc., with one man to drive and another to break down the fertilizer and help load the machine. The machine has advantages over hand application, other than labor saving. The fertilizer is carried from the hoppers to the ground in a rubber hose so that less of it gets on to the cane than by hand application; so long as the hoppers are not allowed to run empty, the distribution will be uniform throughout, a thing we cannot always depend on by hand application.

The wheels being wide apart there is not the same amount of damage in turning at the ends there used to be with the two-row machine. The wider circle required by the three-row instead of two helping in the same direction.

We have not had a chance to do any fertilizing with the machine ahead of planting, but we can see that it will be very advantageous on that work. The fertilizer would be put right in the center of furrow where the seed wants it, none of it would be blown on to the sides to encourage grass as so often happens by hand, through carelessness or if there is any breeze.

"The team that does the sub-soiling behind a furrow plow would have time to do all the fertilizing and still keep up to the plow.

We have also a disc cultivator which does good work ahead of first hoeing. It is inexpensive, light (drawn by one mule) and requires only one operation. It saves the hoes all the work of pulling in all the loose dirt thrown up by the furrow plow, throws nothing to the cane and leaves a rim of grass alongside the cane regulated by one's idea of how close it is safe to go. These

machines are open to anyone's inspection and should they see fit to duplicate or improve on them, we shall be well satisfied to see the good work going ahead."

(Sgd.) JAS. WEBSTER.

MANURE SPREADER.

The Onomea Sugar Company imported an "International Harvester Manure Spreader" from Chicago for spreading Filter Press Cake and Stable Manure. It fills the bill to our entire satisfaction and is a great labor saver; it also handles slaked or ground lime in the same way, having a hood for that special purpose. The great point in its favor is the even distribution.

In conclusion I enclose cuts of several tools issued by Benecia-Horner Co. in case you might care to embody them in your general report, and a diagram and description of the bagging device used at Olaa Mill.

Having nothing further to present at this time, I remain,

Respectfully yours,

JOHN T. MOIR,

Chairman Labor Saving Device Committee for 1906.

J. Watt, Esq.,

Manager Olaa Sugar Co., Ltd.,

Olaa, Hawaii, T. H.

Dear Sir: Enclosed find sketch and short description of bag-holder and filling arrangement as used in the above mill.

The sketch shows plan of holder arrangement, and also elevation of holders and shaker.

The letters on the sketch designate the following parts:

Sh—Sugar bin.
Ah—Holder arms.
T—Track or run-way for holders.
H—Bag-holder.
F—Frame of sugar bin.
S—Shaker.
Sa—Shaker rod.
W—Wheels under bag-holders.
a—Central spindle round which holders swing.
c—Swinging chute from chute of sugar bin.
L—Lever for moving chute.

This bag-holder and filler consists of three arms or holders running on a circular track and round a central spindle.

Track of ½ by 1½ inch iron and tied by angle iron braces and bolts.

The chute is worked by lever "L," lowered to fill bag and raised up to shut off sugar when bag is filled.

The shaker is worked by a cam on the shaft which drives bucket elevator to hopper and is used to shake up and pack the bags.

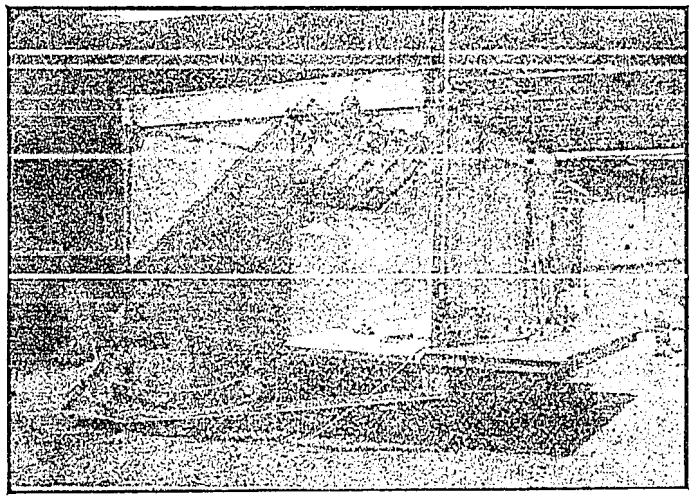
The filling and weighing of the bags in this mill is done by two men, one filling and putting empty sacks on holders and one weighing.

Hoping this may be sufficient information on this subject,

I remain,

Yours respectfully,

JAMES CROLL.



GINACA CANE HARVESTER.

THE GINACA CANE HARVESTER.

The Ginaca Cane Harvester will be, not alone a great labor-saving machine in cutting cane, but also reducing the cost of loading, etc.

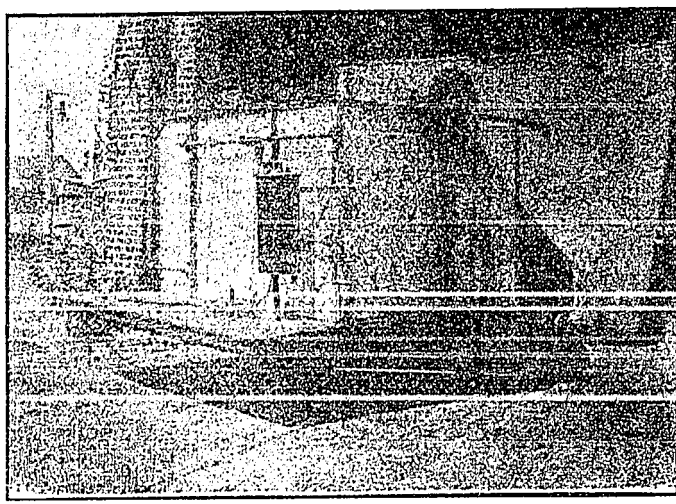
The harvester will be made to cut below the surface of the ground, near the roots—elevate the cut cane, leaves and trash, bind same in bundles of about 500 pounds each and discharge same while in motion.

The machine does not top the cane. Will travel and cut cane at the rate of 80 feet per minute, and with furrows of 5 feet centers will harvest about 3 acres per day, at an expenditure of 1 operator and probably 2 laborers as helpers. The machine is electrically driven, and the improved type to be built will require 25 horse-power. The present motor is 7½ horse-power.

The cutting knives can easily be replaced and ground.

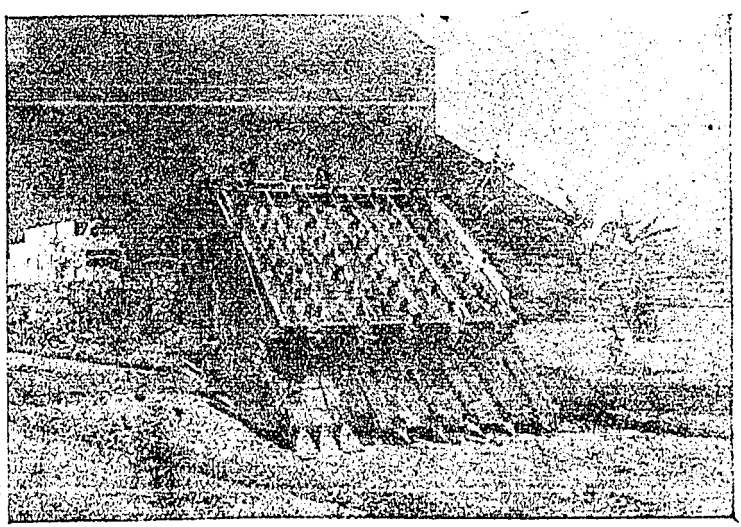
As the knives cut under the surface of the ground, there is a gain of from 2 to 5 inches of cane per stick, and that percentage of cane and sugar.

The cost of topping by hand is nominal in comparison to gain



GINACA CANE HARVESTER.

effected by the machine, not alone in cutting but immense saving of hand labor in loading, as same is bundled, and all that is required is to hook on cable and pull to cars. The cane and trash



GINACA CANE HARVESTER.

and there separated by throwing the trash and tops into a carrier running to trash-house or otherwise, and the good cane on to cane-carrier of mill.

As the machine picks up all the trash, the burning of the fields is done away with. This in itself eliminates the considerable destruction of seed germ, as necessarily follows the burning. With the seed germ untouched by fire or heat from same, the ratoon will stool heavier and have more rapid growth. With the closer cut, the stools are less liable to sour. The preliminary trials have been so highly satisfactory, that an improved harvester will soon be built at a cost of $5,000—approximately.

After the reading of the foregoing reports and the discussions of the same the meeting adjourned to the Experiment Station where half a day was profitably spent in visiting the divisions and inspecting the work conducted there.

The remainder of the meeting was in executive session, where Experiment Station and labor matters were considered and discussed. The work of the Station and the conduct thereof were heartily endorsed and recommendations were made that the operations of the Station be extended and enlarged.

The annual banquet of the Association closed a most successful and enjoyable meeting.